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FOR THE

FISCAL YEAR ENDED JUNE 30, 1900.

TWENTY-FIRST ANNUAL REPORT
OF THE
UNITED STATES GEOLOGICAL SURVEY,
CHARLES D. WALCOTT, Director.

PART V.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1900.

TWENTY-FIRST ANNUAL REPORT

OF THE

UNITED STATES GEOLOGICAL SURVEY

PART V—FOREST RESERVES

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LETTER OF TRANSMITTAL.

Department of the Interior,
United States Geological Survey,
Washington, D. C., July 1, 1900.

Sir: I have the honor to transmit herewith, for publication as a part of the Twenty-first Annual Report, a collection of papers, reports, and maps descriptive of the forests of the West, comprising the Lewis and Clarke Forest Reserve of Montana, the Mount Rainier Forest Reserve and parts of the Olympic Forest Reserve of Washington, the southern portion of the Cascade Range in Oregon, embracing a part of the Cascade Range Forest Reserve, and portions of the Sierra Nevada of California, including the Stanislaus and Lake Tahoe forest reserves and the Yosemite National Park. With these are reports upon the forests of northern Minnesota and of Indian Territory and descriptions of several land-classification sheets, representing areas in various parts of the West.

Very respectfully,
Henry Gannett,
Geographer.

Hon. Charles D. Walcott,
Director United States Geological Survey.

SUMMARY OF FORESTRY WORK IN 1899-1900

BY

HENRY GANNETT

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SUMMARY OF FORESTRY WORK IN 1899-1900.

By Henry Gannett.

CHANGES IN RESERVES DURING THE YEAR.

During the year few changes have been made in forest reserves. By proclamation of October 2, 1899, the Santa Inez Forest Reserve, California, was established, with an area of 227 square miles.

By proclamation of October 21, 1899, the Prescott Reserve, Arizona, was increased by the addition of 646 square miles to its area.

On April 7, 1900, the Olympic Reserve of northwest Washington was reduced by 414 square miles, the reductions being entirely within the area and mainly in the western part of Clallam County. This reduction was made at the earnest solicitation of the county officers and many of the citizens, and is on the whole to the manifest advantage of the reserve, inasmuch as the areas cut out are in large part in private hands.

PRESENT CONDITIONS.

A list of the reserves as at present established is given below, with the date of establishment, their present boundaries, their areas in square miles, and the year in which they were examined.

The present status of the reserves and the national parks is shown by Pl. I.

Names, locations, and areas of forest reserves, July 1, 1900.

Name.	State.	Date of proclamation.	Area.	Remarks.
			Sq. miles.	
Ashland	Oregon	Sept. 28, 1893	290	Examined in 1899.
Battlement Mesa	Colorado	Dec. 24, 1892	1,341	Examined in 1898.
Bighorn	Wyoming	Feb. 22, 1897	1,762	Examined in 1897.
Bitterroot	Idaho-Montana	do	6,480	Examined in 1897 and 1898.
Black Hills	South Dakota-Wyoming.	Sept. 19, 1898	1,893	Examined in 1897.

Names, locations, and areas of forest reserves, July 1, 1900—Continued.

Name.	State.	Date of proclamation.	Area.	Remarks.
			Sq. miles.	
Black Mesa	Arizona	Aug. 17, 1898	2,592	
Bull Run	Oregon	June 17, 1892	222	
Cascade Range	do	Sept. 28, 1893	7,020	Examination commenced in 1899.
Fish Lake	Utah	Feb. 10, 1899	106	
Flathead	Montana	Feb. 22, 1897	2,160	Examined in 1898.
Gallatin	do	Feb. 10, 1899	63	
Gila	New Mexico	Mar. 2, 1899	3,636	
Grand Cañon	Arizona	Feb. 20, 1893	2,893	
Lake Tahoe	California	Apr. 13, 1899	213	
Lewis and Clarke	Montana	Feb. 22, 1897	4,572	Examined in 1899.
Mount Rainier[a]	Washington	do	1,655	Examined in 1898 and 1899.
Olympic	do	Apr. 7, 1900	3,006	Partly examined in 1898 and 1899.
Pecos River	New Mexico	May 27, 1898	205	
Pikes Peak	Colorado	Mar. 18, 1892	288	Examined in 1898.
Pine Mountain and Zaca Lake.	California	June 29, 1898	2,569	
Plum Creek	Colorado	June 23, 1892	280	Examined in 1898.
Prescott	Arizona	Oct. 21, 1899	662	
Priest River	Idaho-Washington.	Feb. 22, 1897	1,008	Examined in 1897.
San Bernardino	California	Feb. 25, 1893	1,152	Examined in 1897.
San Francisco Mountains.	Arizona	Aug. 17, 1898	1,524	
San Gabriel	California	Oct. 20, 1892	868	Examined in 1897.
San Jacinto	do	Feb. 22, 1897	1,152	Examined in 1897.
Santa Inez	do	Oct. 2, 1899	227	
Sierra	do	Feb. 14, 1893	6,400	
South Platte	Colorado	Dec. 9, 1892	1,068	Examined in 1898.
Stanislaus	California	Feb. 22, 1897	1,080	Examined in 1899.
Teton	Wyoming	do	1,296	Examined in 1897.
Trabuco Cañon	California	Jan. 30, 1899	172	
Uinta	Utah	Feb. 22, 1897	1,368	
Washington	Washington	do	5,616	Examined in 1897.
White River Plateau.	Colorado	Oct. 16, 1891	1,872	Examined in 1898.
Yellowstone	Wyoming	Mar. 30, 1891	1,936	Examined in part in 1897.

[a] Act of Congress March 2, 1899, took out Mount Rainier National Park.

SUMMARY OF WORK DONE.

During the past season the Lewis and Clarke and Ashland forest reserves have been examined, the examination of the Mount Rainier Forest Reserve, including the Mount Rainier National Park, has been completed, the examination of the Olympic Forest Reserve has been continued, and work has been commenced in the southern part of the Cascade Range Forest Reserve, where a considerable area, including large tracts east and west of the reserve, has been examined. Also the Yosemite, Sonora, Big Trees, Jackson, Pyramid Peak, and Placerville quadrangles, including the areas of the Yosemite National Park and the Stanislaus and Lake Tahoe reserves, have been examined. The reports upon these areas are presented in full in the present volume and are here summarized.

LEWIS AND CLARKE FOREST RESERVE, MONTANA.

This reserve was examined by Mr. H. B. Ayres, who devoted the entire field season to it. It occupies the whole breadth of the Rocky Mountains in Montana excepting the narrow western slope of Mission Ridge, whose summit forms most of the western boundary of the reserve. The entire area of the reserve is mountainous, consisting of an alternation of ranges and narrow valleys, running nearly north and south. The mountains reach altitudes exceeding 9,000 feet, while the lowest points in the valleys exceed 3,000 feet, most of the valley regions being at considerably greater altitudes.

In general the area is lightly timbered. The summits of many of the ranges reach far above timber line, exposing considerable areas of mountain pasture and rugged rocks. Large areas have been recently burned and are in various stages of restocking. Other still larger areas have been burned in the past and the forests, although thrifty, have not yet reached merchantable size. The total stand of timber upon the reserve is estimated by Mr. Ayres at 2,644,360,000 feet B. M. of merchantable quality, and 11,569,000 cords of wood suitable only for fuel. The amount of merchantable timber is a little less than 1,000 feet per acre for all the land within the reserve. In those portions which are covered with merchantable timber the average stand per acre is probably not greatly in excess of 2,000 feet.

Of the timber upon the reserve nearly one-half is larch, one-fourth red fir, and one-fourth yellow pine, spruce, lodgepole pine, and western white pine.

The forest is, in the main, open, with little underbrush but much fallen timber, the result of former fires.

There is no mining within the limits of the reserve, and very few mineral discoveries have been made.

Owing to the great elevation of the valleys there is little land which can be regarded as agricultural. In the northeastern corner, where the reserve projects into the plains, is an area of perhaps 90 square miles along Birch Creek, which has a sufficiently low altitude and moderate climate to enable agriculture to be carried on. Areas of grass land which afford valuable grazing are scattered over the reserve. They amount altogether to some 200 square miles.

During the summer of 1899 there were three small mills operating within the reserve. The demand for lumber is entirely local, and is largely for railroad ties and firewood.

The areas recently and severely burned are estimated by Mr. Ayres to comprise 1,420 square miles, or about one-third of the reserve. These fires have resulted in leaving large quantities of dead timber standing or fallen upon the ground. That still standing Mr. Ayres estimates at 1,178,000 cords.

Severe burns resulting in the destruction of the forest are commonly followed in this region by a growth of lodgepole pine, whatever may have been the former components of the forest.

MOUNT RAINIER FOREST RESERVE, WASHINGTON.

The examination of this reserve, together with the Mount Rainier National Park, has occupied Mr. Fred G. Plummer, with one assistant, for two seasons. In the following summary it is to be understood that the park is included in the descriptions.

This reserve includes the crest of the Cascade Range, in the southern part of the State, with its slopes upon the east and west. It includes also the great volcanic peak, Mount Rainier, with its massive radiating spurs, and in the south a second great volcanic cone, Mount Adams, but little inferior in magnitude to Rainier. With the exception of Mounts Rainier and Adams, which have altitudes of 14,500 and 12,600 feet, respectively, the greatest elevations found within the reserve are but little over 7,000 feet on the crest of the Cascade Range, and from these heights the land extends to altitudes but a few hundred feet above sea level.

This region is, in respect to its forest cover, sharply divided into two parts by the crest of the range. Upon the west the forest is that of the Pacific coast, with very dense undergrowth. It is very heavy up to altitudes of between 3,000 and 4,000 feet, when it begins to thin, and above 6,000 feet is almost entirely wanting. The forest is composed, in the main, of red fir, with some spruce, hemlock, and cedar. It is heaviest in the valleys and upon the north slopes of the ridges rather than upon the south slopes. East of the crest of the range the forest is comparatively light and open, with little underbrush, and is composed almost entirely of yellow pine.

The entire stand of timber upon the reserve, including the park, is estimated by Mr. Plummer at 20,013,285,000 feet B. M. an average per acre of the timbered land of 9,323 feet B. M. Of the total amount 42 per cent is red or yellow fir, 17 per cent hemlock, 10 per cent yellow pine, and 6 per cent each red cedar and noble fir, the remainder being made up of a variety of species.

Fires have been prevalent and very destructive in this region, having destroyed the timber over many large areas. Among these may be specially mentioned the area south of Mount Rainier, which includes much of the country separating the Nisqually and Cowlitz rivers. Upon the west slope restocking after fires commonly takes place promptly, and the species which appear are similar to those which were destroyed. Upon the east slope, where much drier conditions prevail, restocking is much slower. On the other hand, destructive fires east of the range are very rare, inasmuch as there is little litter or underbrush to carry a fire forward and give it impetus.

There is little or no cutting of timber in this region.

The principal mining within the limits of the reserve is in Summit district on and near the crest of the range, just east of Mount Rainier. The work carried on here is mainly in the nature of development work. Many claims have been taken up and work in a small way is progressing upon them. None of them have as yet reached a productive stage.

OLYMPIC FOREST RESERVE, WASHINGTON.

The examination of this reserve was commenced in the summer of 1898 and was continued during the season of 1899. At the close of the last season about three-fourths of the reserve had been examined. This work has been carried on by Messrs. Arthur Dodwell and Theo. F. Rixon, and a report is herewith presented concerning the portions thus far examined. The area examined comprises 71 townships, some of them fractional, and includes the eastern, northern, and most of the western part of the reserve. It extends into the interior of the reserve far enough to include most of the high summits of the mountain group.

The reserve consists of the Olympic Mountains, which rise to summits exceeding 8,000 feet in altitude, and their slopes upon all sides. Upon the east it extends nearly to Puget Sound, upon the north nearly to the Strait of Juan de Fuca, and upon the west until the recent reduction in its area it extended to the Pacific Ocean.

The areas which were withdrawn were examined by Messrs. Dodwell and Rixon, and reports upon them are presented, together with other portions of the reserve.

The lower country within the reserve up to altitudes of fully 3,000 feet is heavily timbered. The total stand of timber upon the area examined, 2,004 square miles, is 37,100 million feet, an average per acre for the entire area, including that not timbered, of 21,000 feet. There is no part of the State, of equal area, so heavily clothed with forest as this. This enormous body of timber consists of hemlock, 42 per cent; red fir, 26 per cent; silver fir, 15 per cent; cedar, 10 per cent, and spruce, 7 per cent. The streams flowing out of the Olympic Mountains are, in the main, very rapid and shallow, and, with few exceptions, are unfit for driving logs. In order to log this region it will be necessary to build railroads into it to bring the lumber to tide water. Furthermore, there are no harbors on the Pacific coast, which makes it practically imperative that the lumber be carried around either to the Strait of Juan de Fuca or to the head of Puget Sound for shipment. These conditions would doubtless have delayed the destruction of the forests of this region by the ax even if they had not been preserved as a forest reserve.

Fires have been extensive and severe, especially in the northern and northeastern parts of the reserve, where large quantities of timber have been destroyed. Strange to say, in this region of very heavy rainfall, where all the conditions appear to be favorable to forest reproduction, the restocking of these burned areas has made little progress.

Throughout that portion of the reserve which consists of high mountains there are many large areas situated above timber line which afford an excellent summer range for stock, and these will eventually, as settlement progresses in the neighboring regions, become of great value for this purpose.

CASCADE RANGE FOREST RESERVE, OREGON.

The southern portion of this reserve, together with the Ashland Forest Reserve, was examined by Mr. J. B. Leiberg during the past season. His examination included the Ashland and Klamath quadrangles, together with a smaller area lying north of these quadrangles in the Cascade Range. Altogether, in the neighborhood of 8,000 square miles were examined by him. Through the middle of the region which he examined runs the Cascade Range in a general north-south direction, with a great breadth and complexity of features. Upon the east the country drops down in long spurs to the valley of Rogue River, and on the east to the Klamath Lakes and the great plains stretching eastward from them.

In this region we find the same general conditions as prevail in the Mount Rainier Reserve. The crest of the range forms a dividing line between two widely differing sets of forest conditions. Upon the west, with an ample rainfall, the forests are fairly dense and the undergrowth luxuriant. Upon the east, where more arid conditions prevail, the forests are open, with no underbrush. The species differ measurably on the two sides; those on the west side consist largely, if not mainly, of red fir, while upon the east side the forest is characterized by the yellow pine. Of the area examined by Mr. Leiberg a little less than two-thirds, or perhaps 65 per cent, is forested, and 35 per cent not forested, the nonforested areas lying mainly in the extreme west and in the eastern part of the area examined. The amount of timber found upon the forested area is estimated by him as a little less than 20,000 million feet, an average per acre of the forest land of 6,660 feet. Of the total stand of timber upon this area yellow pine comprises 48 per cent, or nearly one-half; red fir 33 per cent, or about one-third; white fir 6 per cent; noble fir and sugar pine each 4 per cent, while the remainder is made up of small amounts of other species. In the portion of the area which lies west of the crest of the Cascade Range red fir is the dominant species, comprising more than half the total amount of timber, yellow pine being next with nearly one-fourth of the total amount. East of the Cascade Range, on the other hand, yellow pine constitutes six-sevenths of all the timber, the remainder being made up of small quantities of other species.

SIERRA NEVADA, CALIFORNIA.

The Yosemite and Sonora quadrangles were examined by Mr. C. H. Fitch. These quadrangles lie upon the west slope of the Sierra Nevada, the western edge of the westernmost being in the foothills, while the eastern edge of the easternmost extends high up into the range, in places far above timber line.

This region presents great simplicity in its forest conditions. From the foothills up to an altitude which is generally about 3,000 feet, but which differs with the exposure, the country is covered with chaparral of various species, among which are scattered oaks and digger pines. At an altitude of about 3,000 feet yellow pine appears, and quickly becomes the dominant vegetation, covering the country with an open forest. A little above the lower margin of the yellow pine, sugar pine appears, interspersed with the yellow pine, and a little higher up cedar and red fir. This type of forest consists in the main of yellow pine, secondarily of sugar pine, with a small percentage of cedar and fir, and extends to an altitude of something over 8,000 feet, forming a broad belt 40 or 50 miles in width on the slope of the range. At greater altitudes the timber changes to lodgepole and white-bark pine and balsam fir, the white-bark pine becoming the dominant timber-line tree.

The stand of timber in this belt ranges from 10,000 to 50,000 feet per acre. Nearly all the timber is of merchantable size and quality. There is little young growth, and the forest is everywhere open, with little underbrush.

It is in the midst of this forest that occur the groves of big trees (*Sequoia gigantea*). Within the area here indicated are four such groves, the Mariposa, Merced, and two Calaveras groves. The big trees do not form a pure forest in any case, but are interspersed among the other components of the forest, forming really but a small proportion.

The stand of timber upon these quadrangles is estimated as follows:

	M. Feet B. M.
Sonora	1,000,000
Yosemite	10,000,000

The Markleeville, Pyramid Peak, Placerville, Dardanelles, Big Trees, and Jackson quadrangles were examined by Mr. George B. Sudworth. These quadrangles comprise an area of approximately 6,000 square miles, extending from the San Joaquin Valley on the west eastward across the Sierra Nevada into the deserts of Nevada, including a complete section of the great range of California. They include also nearly the entire areas of the Stanislaus and Lake Tahoe forest reserves. A small portion of the Stanislaus Reserve extends eastward beyond the Dardanelles quadrangle, and a small portion of the Lake Tahoe Reserve extends north of the Pyramid Peak quadrangle. These projections are small in area and of little importance so far as timber is concerned.

Up to an altitude of approximately 2,500 feet the foothills of the Sierra Nevada, which are represented upon the Jackson and Placerville sheets, are covered with chaparral of varying density, among which are scattered digger pines and oaks. At an average altitude of 2,500 feet, ranging in some places up to 3,000, the vegetation changes with considerable abruptness, and a forest consisting at first of yellow pine, but soon reenforced by incense cedar, red fir, and sugar pine, covers the land. This forest is open, with little underbrush; indeed, at present there is little vegetation of any sort other than trees.

This type of forest extends upward to an altitude of between 8,000 and 9,000 feet when the species change to more arctic ones, including lodgepole pine, western white pine, black hemlock, California red fir, and at the greatest altitudes, as a timber-line tree, white-bark pine. Ascending in this third zone, the density of the timber rapidly diminishes, and finally the forest consists only of scattered individuals. This is due in part to the altitude and in part to the fact that the surface consists mainly of bare granite rock upon which, since the recent recession of glaciers, little soil has as yet accumulated.

The commercial timber is found mainly in the middle belt, and consists principally of yellow and sugar pines. The stand ranges from 2,000 feet up to 50,000 feet per acre in exceptional cases. The total amount of timber estimated upon each of these quadrangles is as follows:

	M feet B. M.
Placerville	1,600,000
Jackson	40,000
Pyramid Peak	3,400,000
Big Trees	3,750,000
Markleeville	320,000
Dardanelles	3,000,000

In the early mining days, between 1850 and 1860, much of this timber was cut away, and great areas are now covered with a young growth, mainly of yellow pine, which is the principal tree to reproduce. Mining is still carried on in this region, but on a much more limited scale, and the destruction of timber for the supply of mines is not great.

There is some cutting of timber in this region, but it is entirely to supply local demands, none being exported.

The stand of timber upon the two reserves is as follows:

	M feet B. M.
Stanislaus Reserve	2,000,000
Lake Tahoe Reserve	322,500

LAND-CLASSIFICATION MAPS.

There are presented, as a part of this report, a number of land-classification maps representing the distribution of the surface into wooded, pasture, and cultivated lands. The first is in most cases subdivided as lands containing merchantable timber, lands containing timber not merchantable, and cut and burned lands, in case timber is regrowing upon them.

The sources of the data from which this information has been derived are in most cases cited upon the sheets or in the text of the report. In general, the primary subdivision into woodland, pasture land, and cultivated land has been made by the topographers while making the topographic maps, and in some cases the delimitation of the cut and burned areas has also been furnished by them. In other cases this information has been compiled from other sources, partly from the reports of cruisers.

The stand of timber upon the timbered areas has been derived, in the main, from the reports of cruisers and from information in the possession of forest agents in the employ of this division.

INDIAN TERRITORY.

In the prosecution of the subdivisional surveys of Indian Territory accurate maps of the extent of woodland were made. These have been compiled and placed upon a reduced map of the Territory, upon a scale of 1:500000, which forms a part of this report. With this is a description of the woodland of the Territory, derived from the reports made by the subdivision surveyors. These reports have been compiled and prefaced by Mr. Fitch, and are presented with the map and summary of the forest conditions of this region.

MINNESOTA.

During the past year Mr. H. B. Ayres, in addition to his duties in the examination of the Lewis and Clarke Forest Reserve, has been actively engaged in collecting data from timber-land owners, lumbermen, and cruisers regarding the woodlands of the pine region of Minnesota. These data have been collected in part by correspondence and in part by personal visits by Mr. Ayres, and have been supplemented by his own intimate knowledge of the region. The results are presented upon a map showing, in all the detail which the scale will admit, the character of these lands as concerns the timber supply. Explanatory text, with estimates, etc., accompanies the map.

RATE OF GROWTH OF FOREST TREES.

Incidental to the work of the forestry agents in the examination of forest reserves, some information has been obtained concerning the rate of growth of different species of trees under different conditions of soil, moisture, and exposure. Most of these figures have been published in scattering form among the various reports. They are here brought together in condensed shape in order that the bearings and relations of the information may be brought out. Most of the figures given are the average of a large number of measurements.

The following table gives the species of tree, the locality in which the measurements were made, the number of years required to produce one inch of growth in diameter at the butt, and finally the authority or source of information.

Rate of growth of forest trees.

Locality.	Years per inch.	Authority.
RED FIR.		
West slope of Olympic Mountains, Washington	4.8	U. S. Geological Survey.
North slope of Olympic Mountains, Washington	6.0	Do.
East slope of Olympic Mountains, Washington	6.1	Do.
Center of Olympic Mountains, Washington	6.1	Do.

Rate of growth of forest trees—Continued.

Locality.	Years per inch.	Authority.
RED FIR—continued.		
Cascade Range, northern Washington	4.1	U. S. Geological Survey.
Cascade Range, Washington, Mount Rainier Reserve	5.8	Do.
Oregon	4.9	Pinchot and Graves.
Bitterroot Reserve, Idaho	5.8	U. S. Geological Survey.
Colorado	7.2	Do.
GREAT SILVER FIR.		
West slope of Olympic Mountains, Washington.	5.5	U. S. Geological Survey.
North slope of Olympic Mountains, Washington.	6.4	Do.
East slope of Olympic Mountains, Washington.	7.5	Do.
Center of Olympic Mountains, Washington.	6.9	Do.
Mount Rainier Reserve, Washington	4.4	Do.
Bitterroot Reserve, Idaho	6.7	Do.
YELLOW PINE.		
Mount Rainier Reserve, Washington	7.0	U. S. Geological Survey.
Bitterroot Reserve, Idaho	4.3	Do.
Black Hills, South Dakota	7.8	Do.
Colorado	9.3	Do.
LODGEPOLE PINE.		
Mount Rainier Reserve, Washington	8.0	U. S. Geological Survey.
Bitterroot Reserve, Idaho	8.3	Do.
Pikes Peak Reserve, Colorado	13.7	Do.
White River Plateau Reserve, Colorado	11.7	Do.
HEMLOCK.		
West slope of Olympic Mountains, Washington.	6.8	U. S. Geological Survey.
North slope of Olympic Mountains, Washington.	7.3	Do.
East slope of Olympic Mountains, Washington.	7.4	Do.
Center of Olympic Mountains, Washington.	7.2	Do.
Cascade Range, Washington	10.0	Do.
Mount Rainier Reserve, Washington	8.6	Do.

Rate of growth of forest trees—Continued.

Locality.	Years per inch.	Authority.
SPRUCE.		
West slope of Olympic Mountains, Washington.	3. 7	U. S. Geological Survey.
North slope of Olympic Mountains, Washington.	3. 9	Do.
East slope of Olympic Mountains, Washington.	6. 7	Do.
Cascade Range, Washington	3. 3	Do.
CEDAR.		
West slope of Olympic Mountains, Washington.	4. 6	U. S. Geological Survey.
North slope of Olympic Mountains, Washington.	5. 8	Do.
East slope of Olympic Mountains, Washington.	6. 7	Do.
Center of Olympic Mountains, Washington	7. 0	Do.
Cascade Range, Washington	4. 3	Do.
Mount Rainier Reserve, Washington	4. 4	Do.
ENGELMANN SPRUCE.		
Mount Rainier Reserve, Washington	5. 5	U. S. Geological Survey.
Bitterroot Reserve, Idaho	8. 3	Do.
Colorado	10. 0	Do.
REDWOOD.		
Mendocino County, California	10. 0	California Board of Forestry.
Smith River, California	3. 0	
ALPINE FIR.		
Mount Rainier Reserve, Washington	7. 8	U. S. Geological Survey.
Bitterroot Reserve, Idaho	7. 5	Do.
Colorado	9. 6	Do.
BLUE SPRUCE.		
Colorado	6. 0	U. S. Geological Survey.
WESTERN WHITE PINE.		
Mount Rainier Reserve, Washington	3. 5	U. S. Geological Survey.
Bitterroot Reserve, Idaho	5. 9	Do.
WHITE-BARK PINE.		
Mount Rainier Reserve, Washington	14. 5	U. S. Geological Survey.
Bitterroot Reserve, Idaho	9. 6	Do.

Rate of growth of forest trees—Continued.

Locality.	Years per inch.	Authority.
WESTERN LARCH.		
Bitterroot Reserve, Idaho	8.0	U. S. Geological Survey.
LYALL LARCH.		
Bitterroot Reserve, Idaho	11.0	U. S. Geological Survey.
PATTON SPRUCE.		
Mount Rainier Reserve, Washington	12.0	U. S. Geological Survey.

An examination of this table shows that while different species grow at different rates the variation in the rate of growth in the case of individual species, due to differing conditions of rainfall, exposure, altitude, etc.—in other words, to different conditions of environment—far exceeds the range due to difference of species; for instance, in the northern Cascades of Washington the red fir requires but 4.1 years to grow 1 inch in diameter, while in Colorado it requires 7.2 years to do the same thing, a difference of 3.1 years, due to difference in environment. This tree is, under favorable conditions, one of the most rapid growers among forest trees, and its average rate of growth, as deduced from the observations here recorded, is 5.7 years to an inch. The hemlock, which is a tree of slow growth, averages an inch in 7.9 years, a difference of but 2.2 years from the average rate of growth of red fir.

An examination of the table shows that in general all species grow most rapidly where the rainfall is heaviest, and least rapidly in arid regions; that they grow less rapidly under cold conditions, such as prevail upon high mountains, than in lower, and consequently warmer, regions. The effect of environment upon them is shown most markedly in the case of the redwoods. In Mendocino County, California, which is toward the southern part of their habitat, the climate is now evidently not well suited to them, being too dry and probably too warm. Here where for centuries they have not reproduced by seed, but only by sprouting from stumps, the average time required to grow an inch in diameter is 10 years. On the other hand, upon Smith River, in northwestern California, near the north line of their habitat, where the conditions have changed much less from those which prevailed when the redwood was in its prime, the rate of growth is more than three times as great, being an inch in 3 years, probably the most rapid growth of any of our native forest trees.

LEWIS AND CLARKE FOREST RESERVE, MONTANA

BY

H. B. AYRES

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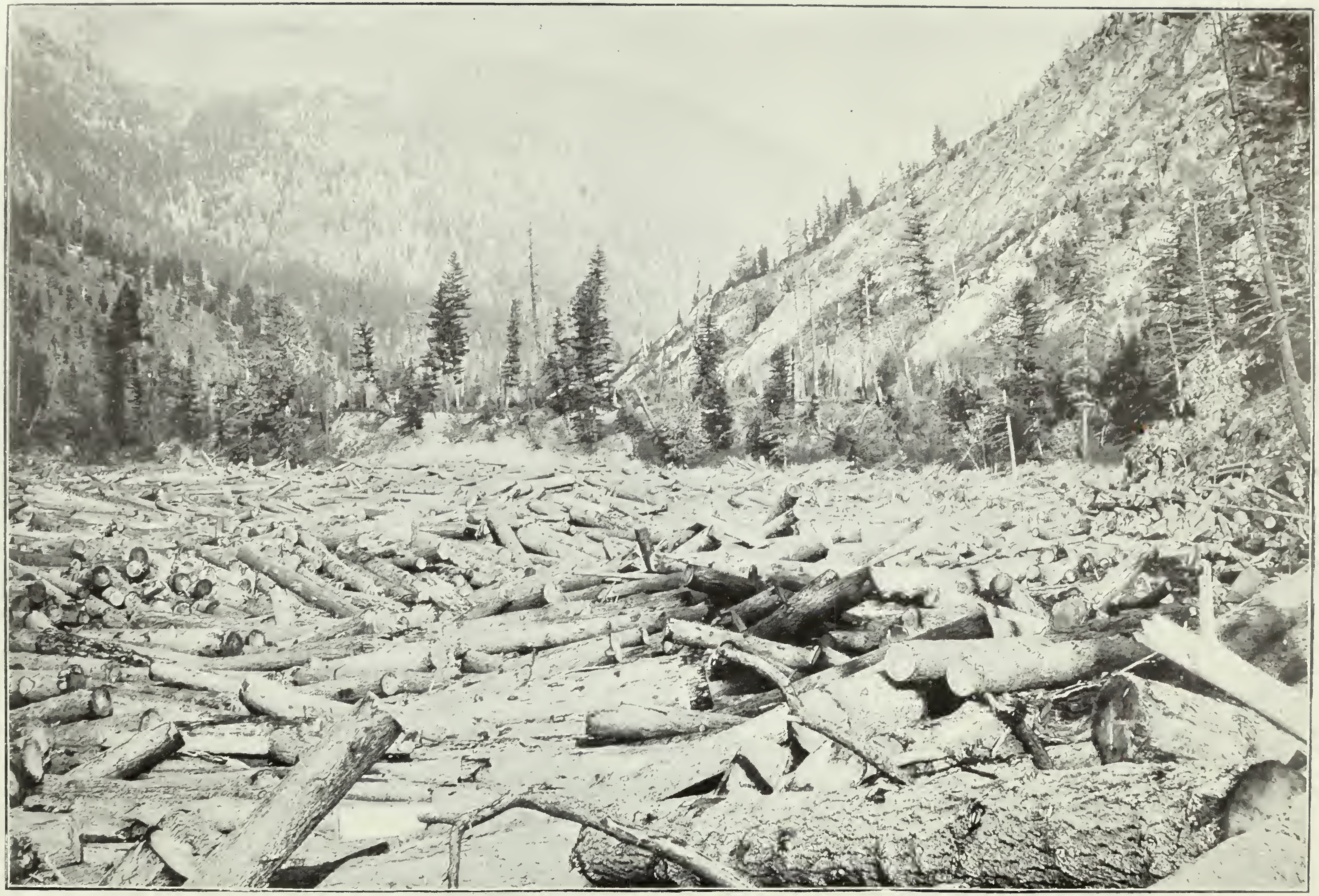


JAM OF LOGS IN BLACKFOOT RIVER.

LEWIS AND CLARKE FOREST RESERVE, MONTANA.

By H. B. Ayres.

BOUNDARIES.

The boundaries of this reserve, as established by Executive order of February 22, 1897, are as follows:

Beginning at the point on the south boundary of the Blackfeet Indian Reservation where said boundary line is intersected by the range line between ranges eight (8) and nine (9) west principal meridian, Montana; thence southwesterly along the south boundary to the southwest corner of said reservation and northwesterly along the west boundary thereof, as defined and described in the act of Congress approved June tenth, eighteen hundred and ninety-six, entitled "An act making appropriations for current and contingent expenses of the Indian Department and fulfilling treaty stipulations with various Indian tribes for the fiscal year ending June thirtieth, eighteen hundred and ninety-seven, and for other purposes," to the point where the unsurveyed range line between ranges twelve (12) and thirteen (13) west will intersect said boundary line; thence southerly along said unsurveyed range line to the point for the northeast corner of township twenty-nine (29) north, range thirteen (13) west; thence westerly along the unsurveyed township line to the point for the northwest corner of said township; thence southerly along the unsurveyed range line to the point for the southwest corner of section eighteen (18), said township; thence westerly along the unsurveyed section line to the point for the northwest corner of section nineteen (19), township twenty-nine (29) north, range fourteen (14) west; thence southerly along the unsurveyed range line to the point for the southwest corner of said township twenty-nine (29) north, range fourteen (14) west; thence westerly along the unsurveyed seventh (7th) standard parallel north to the point for the southeast corner of township twenty-nine (29) north, range seventeen (17) west; thence northerly along the unsurveyed range line to the point for the northeast corner of said township; thence westerly along the unsurveyed township line to the point for the northwest corner of section three (3), said township; thence northerly along the unsurveyed section line to the point for the northeast corner of section four (4), township thirty (30) north, range seventeen (17) west; thence westerly along the unsurveyed township line to the point for the northwest corner of section three (3), township thirty (30) north, range nineteen (19) west; thence southerly along the unsurveyed and surveyed section line, subject to the proper offset on the seventh (7th) standard parallel north, to the southeast corner of section twenty-one (21), township twenty-eight (28) north, range nineteen (19) west; thence easterly along the unsurveyed section line to the point for the southeast corner of section twenty-four (24), said township; thence southerly along the unsurveyed and surveyed range line to the southeast corner of township twenty-seven (27) north, range nineteen (19) west; thence easterly along the surveyed and unsurveyed township line to the point for the northwest corner of section three (3), township twenty-six (26) north, range eighteen (18) west; thence southerly along the unsurveyed section line to the point for the southwest corner of section thirty-four (34), said township; thence westerly along the unsurveyed and surveyed township line to its intersection with the east shore of Flathead Lake; thence southerly along the shore of said lake to the north boundary of the Flathead Indian Reservation; thence easterly along the north boundary to the northeast corner of said reservation and southerly along the east boundary thereof to the point where said boundary line will be intersected by the unsurveyed fourth (4th) standard parallel north; thence easterly along said unsurveyed parallel to the point for the southeast corner of township seventeen (17) north, range seven (7) west; thence northerly along the unsurveyed range line to the point for the northeast corner of said township; thence westerly along the unsurveyed township line to the point for the northwest corner of said township; thence northerly along the unsurveyed range line to the point for the northeast corner of township eighteen (18) north, range eight (8) west; thence westerly along the unsurveyed township line to the point for the southeast corner of township nineteen (19) north, range nine (9) west; thence northerly along the unsurveyed and surveyed range line between ranges eight (8) and nine (9) west, subject to the proper offsets on the fifth (5th), sixth (6th), and seventh (7th) standard parallels north, to the point of intersection with the south boundary of the Blackfeet Indian Reservation, the place of beginning.

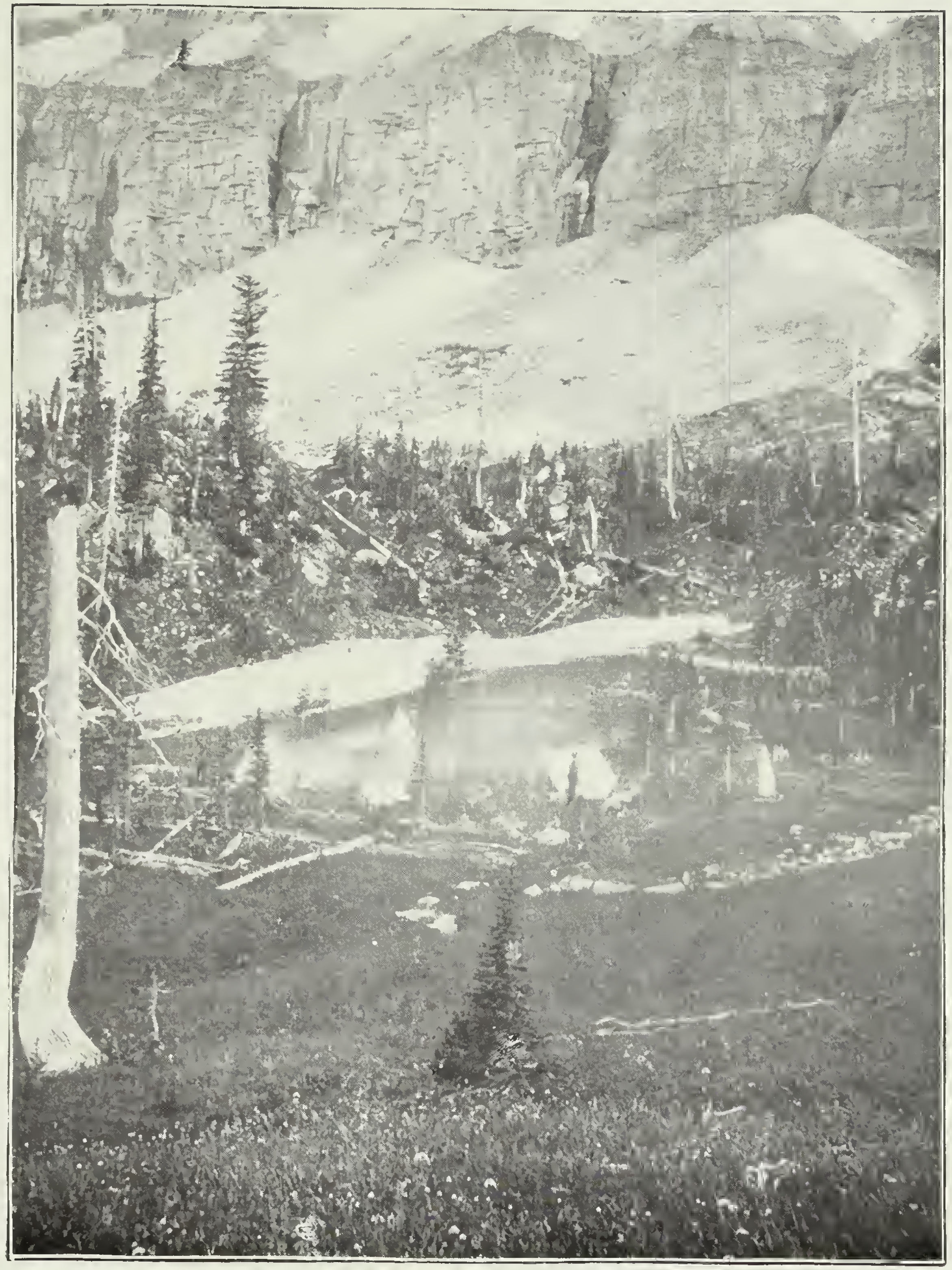
TOPOGRAPHY.

The area of the reserve is 4,572 square miles, or 2,926,000 acres. It occupies the whole breadth of the Rocky Mountains, excepting the narrow western slope of Mission Ridge, the summit of which forms the greater part of the western boundary. The Rocky Mountains here consist of four parallel ranges, usually sharp and distinct, the western two especially so, with long, narrow valleys between them (Pl. IV, *A*). These valleys are drained principally by northward-flowing streams, but the eastern range is cut across about the middle of the eastern boundary by Sun River, which drains a great portion of the next valley west of the eastern range into the Missouri River. The North Fork of Dearborn River also drains the southeastern portion of the reserve to the eastward. Across the whole reserve from McDonald Peak on the west to Mount Dearborn on the east is a transverse divide, forming a watershed between the streams flowing north into the Flathead River and those flowing south into the Blackfoot River. The principal peaks of the main ranges are between 7,000 and 10,000 feet in altitude, while the main valleys are between 3,000 and 5,000 feet.

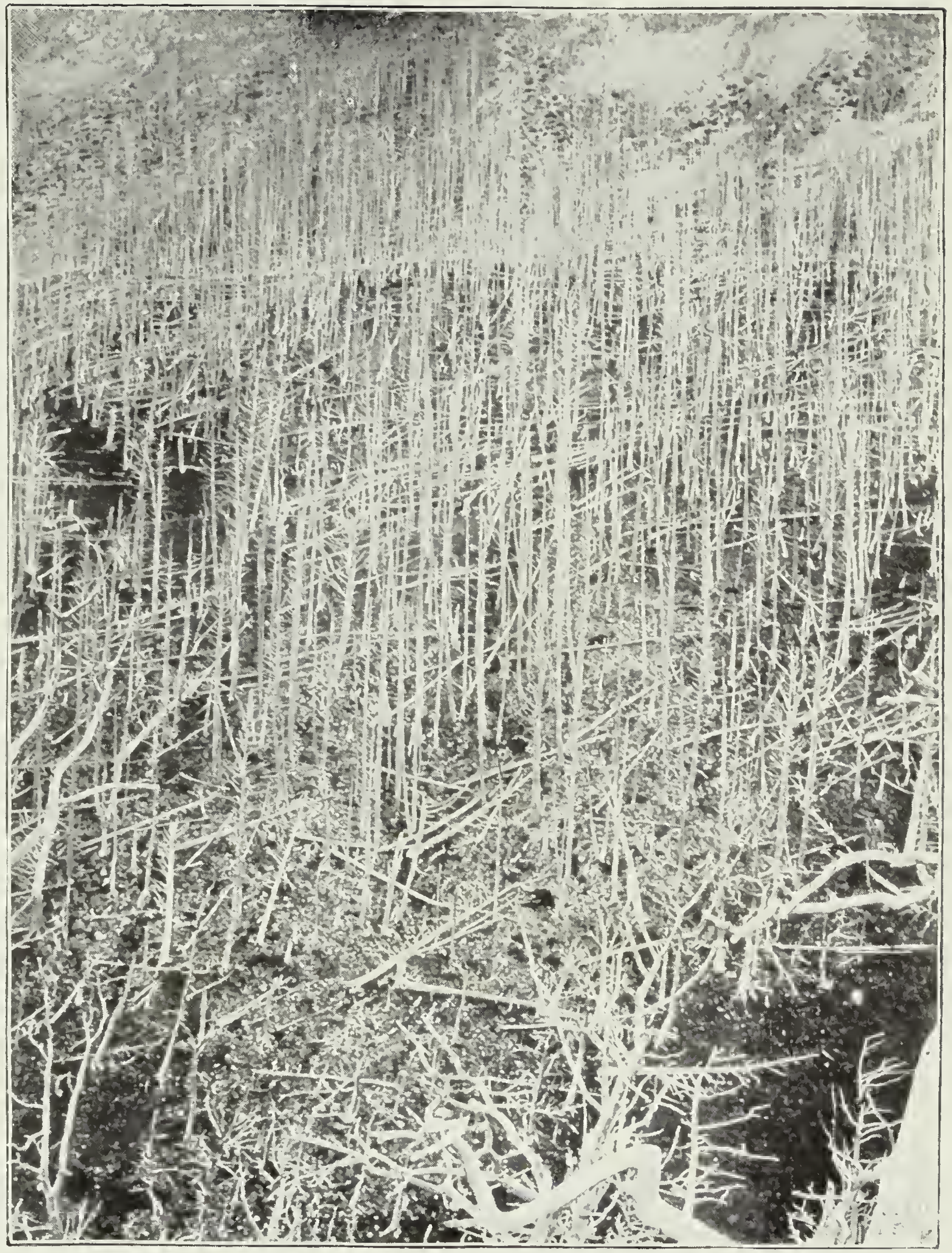
The reserve is naturally divided by the mountains into four large areas: First, the portion which is drained eastward, having an area of about 1,600 square miles; second, that drained northward by the Middle Fork of Flathead River, having an area of about 576 square miles; third, the long valley of the South Fork of Flathead River, which is continuous with the valley of the North Fork of Blackfoot River, the two having an area of about 1,860 square miles; fourth,

A. VIEW ALONG SUMMIT OF EASTERN RANGE.

B. MOUNTAINS OF LIMESTONE, NORTH FORK OF TETON CREEK.



A. HEAD OF NORTH FORK OF SUN RIVER, AGAINST WALL OF CONTINENTAL DIVIDE.



B SEVERE BURN ON MOUNTAIN SIDE.

the Swan-Clearwater Valley, more regular in outline and with broader bottom and lower altitude, having an area within the reserve of about 728 square miles. The valley of Swan River is continuous with that of the Clearwater, being separated only by a low morainic divide.

ROCK.

Limestone is of extensive occurrence, nearly all the summits, both of the peaks and ridges, being composed of it. Much of it is fossiliferous (Pls. IV, *B*, and V, *A*). Most of it is said to be of good quality for building stone.

Interbedded quartzites are occasionally seen, and green schistose rocks are found in the canyons. One especially good exposure of schist is in the lower canyon of the North Fork of Teton Creek.

Igneous rock, bearing traces of copper, occurs on Upper Smith Creek, southwest of Augusta, and extends southwestward. A dark igneous rock is also found extending northward from the warm springs on Sun River.

Black shale is abundant in the valley of the North Fork of Sun River. A bright-red arenaceous shale extends from near the warm springs southward to the headwaters of Ford Creek.

Cretaceous rocks form the eastern foothills. Tertiary coal-bearing rocks are found in the lower portion of the valley of the South Fork of the Flathead.

Few mining prospects are found within the reserve. Those seen were on Smith Creek and in the lower portion of the valley of the South Fork of Flathead River. Quartz is nowhere abundant.

Outside of the reserve, but not far from the boundary, copper claims are located on the North Fork of Blackfoot River, and on Smith Creek, below White's mill. Some other claims were staked during 1898 on Summit Creek, not far above Java.

Lignite coal is found on the South Fork of Flathead River, some 30 miles from its mouth.

East of the Continental Divide the strata dip southwestward, and west of the divide the general dip is northeastward.

SOIL.

In general the soil is shallow. The region has been glaciated in comparatively recent time and but a small amount of soil has accumulated. The rock of the region being principally limestone, one expects the soil derived from it to be productive where physical composition, moisture, and climate are favorable to plant growth. Travel through the region proved this to be true, for in all the well-moistened and sheltered localities having a fair depth of loam a luxuriant growth of vegetation was found. Thrifty vegetation is by no means a simple index of the character of the soil on which it grows, but, considering the other factors influencing the growth of plants, it is an easy means of discovering the value of the soil.

In the higher regions, or those above 6,000 feet, a large proportion of the surface is entirely destitute of soil, as it has been washed down the mountain sides as fast as formed. The middle slopes vary greatly as to soil, and while in some of the basins or on the more moderate slopes there is an accumulation of loam, many strips on the mountain sides are nearly bare. Even where slopes are moderate there are many very steep and even precipitous places where nothing but rock is exposed. The valleys contain a great deal of gravel, morainal material brought down from the mountains by glaciers and worked over by water in more recent times. Clay was seen in many of the river bluffs and in terraces along the sides of the valleys. The distribution of clays and gravels is so irregular that it would be impracticable to make a satisfactory map of them.

HUMUS.

Humus is generally light, varying according to the fertility of the soil and favorable climatic conditions. The eastern slope has been burned so much that there is little humus left, except in the lower foothills (Pl. VI, *A*). The summits of the mountain ridges have, of course, very little humus, as not much vegetation grows there. The river bottoms here, in contrast with bottom lands in low countries or regions of moderate slope, have so much gravel and sand that they do not produce a rank growth of vegetation; consequently there is but little humus on them.

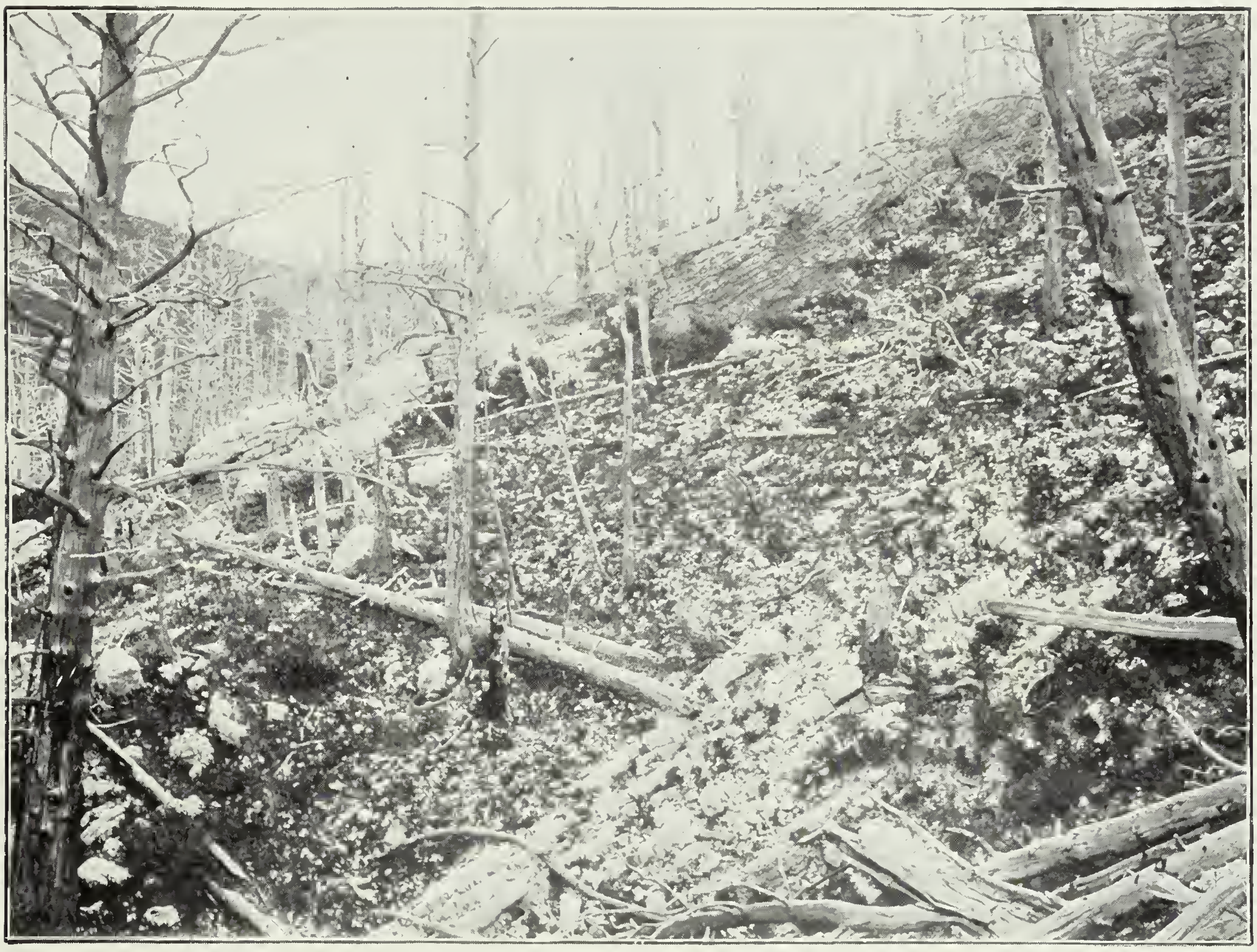
In general, the earth is but slightly covered with humus, even the unburned woods seldom having a depth of more than 2 or 3 inches. There are exceptions, of course, in damp places along small streams, in springy places, and in the isolated sloughs.

In the banks of small streams that have changed their courses several feet of black earth sometimes appear. This, however, is an alluvial deposit washed down from the hills by the streams, and is not to be considered as humus.

LITTER.

While varying somewhat with the fertility of the soil, the amount of litter depends greatly upon the occurrence and the intensity of fire. It is scant on all the higher land, where the soil is thin, climate severe, and vegetation restricted, but it is found on burned areas, on mountain sides, and in valleys (Pl. V, *B*).

On the burned areas shown on the accompanying map (Pl. III) there is very little material except the trunks of trees killed by fire, but these in many cases amount to a large number.



A. BURNT MOUNTAIN SIDE NOT RESTOCKED.

New vegetation of grass, lupine, rose, service berry, paint weed, etc.

B. HANNON'S RANCH AND VALLEY OF STOREHOUSE CREEK.

A. MISSION RANGE, FROM HOLLAND'S RANCH.

B. YELLOW PINE, NEAR HOLLAND'S RANCH, UPPER SWAN RIVER VALLEY.

The forested region not visited by recent fires has a very small amount of deadwood, usually very much less than is found on the burns, but here is much more of the fine litter, such as leaves, twigs, and moss.

Except for deadwood, the amount of litter is light east of the Continental Divide, and heavy in the unburned portion of the valley of the Middle Fork of Flathead River, where the old forest is being slowly replaced by new. It is moderately abundant in the valley of the South Fork of Flathead River, which is patched with burns. The lower half of the Swan River Valley is in about the same condition, but the upper half has been much burned and has a dense network of fallen trees over a large part of the surface.

AGRICULTURAL AND GRAZING LANDS.

Excepting that angle of the reserve reaching northeastward into the plains, with Birch Creek as its northern boundary, and having an area of about 90 square miles, there is no strictly agricultural land within the reserve. In each of the main valleys some vegetables and hay could be grown, but the product could not compete successfully with that produced under more favorable conditions.

While agricultural land is scarce, there are several favorable locations for small ranches (Pl. VI, *B*). These areas, excepting along the eastern foothills, are isolated and difficult of access and subject to deep snows in winter, which would make it necessary for the rancher to put up much hay. Natural hay is found in some quantity in willow bottoms, or sloughs, and some prairies would yield a good crop of hay under cultivation. On the North Fork of Sun River is a prairie having an area of about 10 square miles, on which there is but little natural hay, but the land could easily be irrigated, and timothy could be grown.

South of Sun River the valleys of Beaver Creek and of the South Fork of the North Fork of Sun River have considerable areas of grass land. All through the foothills bordering the plains and in the narrow valleys between the ridges south of Ear Butte are, perhaps, 100 square miles of land on which there is more or less grass, but it is rather difficult of access and undesirable for grazing on account of the deadwood killed by fires. This area, with the eastern foothills northward, has once been nearly all wooded, but frequent incursions of fire from the plains have reduced and even exterminated much of the forest, which has been succeeded by a mixture of grasses and weeds.

In the valley of the Middle Fork of the Flathead only one area of grass land was seen, and that was a willow bottom along a stream tributary to the Big, or East Fork. This area seemed to be about a mile long and a quarter to half a mile wide.

Near the head of Willow Creek is a large willow bottom with bunchgrass prairie on the hills bordering it. Mr. Donahue has a ranch on this bottom stocked with about 100 head of cattle.

Below the mouth of Willow Creek is an area of 800 to 1,000 acres of grass land, much of which is fire made, affording excellent summer grazing. Hay could easily be grown here by irrigation. A short distance above the mouth of White River is an area of about 300 acres of prairie. Here and there, in passing down the South Fork, small areas of grass were found on the most gravelly portions of the river bottom.

In the Clearwater Valley, about the head of Clearwater Lake and about the other lakes of the chain between this lake and the summit, are meadows of sedge, or flat grass, with small areas of upland grass. The grass and hay land in the Clearwater drainage amounts to perhaps 500 acres.

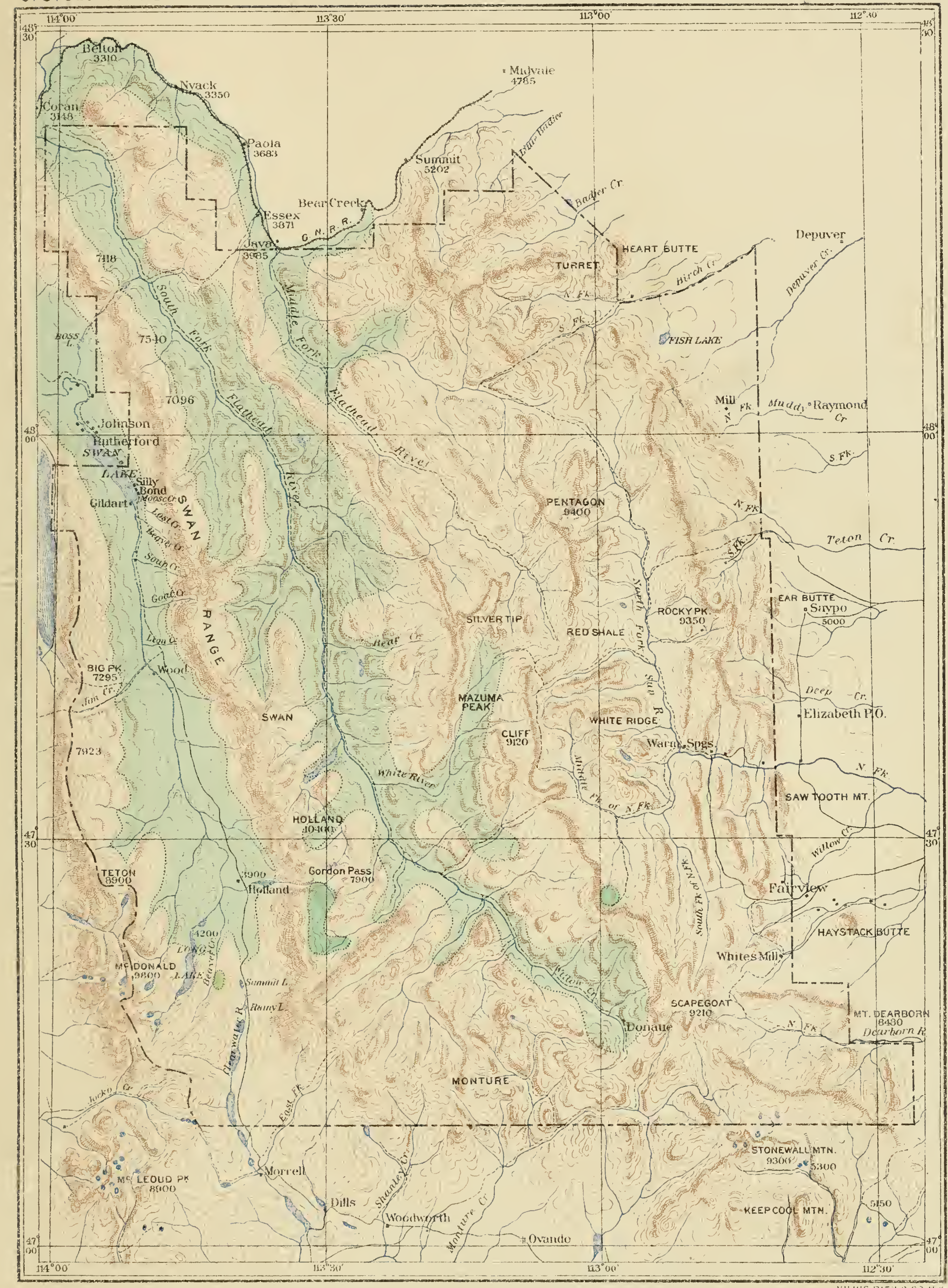
Over the divide, in the Swan River Valley, on Holland Creek, are some 200 acres of natural prairie land, with fair grazing also under the adjacent scattered timber. This land is occupied as a ranch (Pl. VII, *A*).

About 8 or 10 miles below this ranch is a morainic region of gravel hills and ridges, with intermediate sloughs, on which there is much grass of inferior quality (Pl. IX, *A*). The abundance of hay may, however, offset the inferior quality of pine grass and induce some one to try ranching there.

Above the mouth of Jim Creek, on the trail to Crow Creek Pass, is a prairie of some 500 acres, part of which is irrigable and well adapted to hay.

At the head of Swan Lake are about 500 acres of hay land, but there is very little grazing land in that vicinity. Numerous small areas of grass land occur elsewhere in this valley, but none of them warrant an attempt at stock raising.

On the mountain ridges, approaching timber line, are many grassy basins and parks, and many ridges are scantily covered with a fine blue bunch grass (*Festuca ovina?*). This mountain grass land is probably due to the prevalence of snow, which prevents growth of trees. The lingering snow leaves hardly more than two months of the year available for pasturage. Most of such areas are practically inaccessible for stock and are of no present use as grass land. In the entire reserve there are probably 200 square miles of grass land.



JULIUS BIEN & CO. N.Y.

LEWIS AND CLARK FOREST RESERVE
MONTANA
Showing distribution of Lyall larch, Western larch, and Patton hemlock
Prepared under the direction of Henry Gannett, Geographer in charge
BY H. B. AYRES

Scale
5 0 5 10 15 20 25 30 Miles
Sketch contours
1899

LEGEND

🟩 LYALL LARCH (Larix Lyallii)
▭ WESTERN LARCH (Larix occidentalis)
🟩 PATTON HEMLOCK (Tsuga patoneana)

THE FOREST.

SPECIES.

The trees growing within the reserve are as follows:

Trees growing within Lewis and Clarke Forest Reserve, Montana.

Botanical name.	Common name.	General distribution.
Pinus ponderosa	Yellow pine	Swan-Clearwater Valley and South Fork of Flathead.
Pinus monticola	White pine	Lower Swan River, South Fork and Middle Fork of Flathead.
Pinus murrayana	Lodgepole pine	Everywhere below 7,000 feet.
Pinus albicaulis	Nut pine	West of Continental Divide above 6,000 feet.
Pinus flexilis	Limber pine	East of Continental Divide.
Picea engelmanni	Engelmann spruce	Everywhere.
Picea alba	White spruce	Teton Creek.
Larix occidentalis	Western larch	West of Continental Divide.
Larix lyallii	Mountain larch	Colonies on highest ranges.
Pseudotsuga taxifolia	Red fir	Everywhere below 7,000 feet.
Abies lasiocarpa	Balsam	Everywhere.
Abies grandis	Silver fir	Lower Swan and Flathead valleys.
Thuja plicata	Cedar	Do.
Tsuga heterophylla	Hemlock	Do.
Tsuga pattoniana	do	Do.
Populus angustifolia	Cottonwood	Along lower streams.
Populus tremuloides	Aspen	Patches below 7,000 feet.
Populus balsamifera	Balm of Gilead	Eastern foothills.

DISTRIBUTION.

Yellow pine is found throughout the valley of the South Fork of Flathead River and in the Swan and Clearwater valleys below 3,500 feet (Pl. IX, *B*). White pine occurs in the Lower Swan River Valley, in the lower portion of the valley of the South Fork of Flathead River, and probably in the lower portion of the Middle Fork Valley, at elevations below 4,000 feet. Lodgepole pine is general in distribution below 6,000 feet. Nut pine is found on all the high land west of the Continental Divide above 5,000 feet. Limber pine is confined to the eastern foothills below 7,000 feet (Pl. X, *A*). Engelmann spruce is generally distributed and is found at all altitudes, but most abundant on the mountain sides. White spruce, somewhat difficult to distinguish from Engelmann spruce because of intermediate forms, occurs on the South Fork of Teton Creek. Larch is the principal timber tree in the Swan-Clearwater Valley. It is less abundant in the valley of the South Fork of Flathead River, and its farthest appearance to the eastward is in the valley of the Middle Fork of Flathead River. Mountain larch is found in colonies here and there on the higher mountains. An unusually fine forest (for this species) is near Camp Creek Pass, between Sun River and Willow Creek, on the very summit of the Continental Divide. A few trees are found also on the summit of the range just north of Pend Oreille Pass, between the West Fork of the South Fork of Flathead River and the Clearwater Valley. Red fir is found throughout the reserve below 6,000 feet. Balsam, like Engelmann spruce, is found at all altitudes, but is most abundant between 4,000 and 6,000 feet. Silver fir appears in the lower portion of the Swan River Valley, on the South Fork of Flathead, on the Middle Fork of Flathead, and a few trees are seen near the head of the North Fork of Sun River. Cedar has the same distribution, but is confined to the damp places along streams and in the bottoms of ravines. Hemlock has the same habitat and approximately the same distribution as cedar. Mountain hemlock is found only at the summit of the pass between Swan River and Clearwater River, in a clump of small trees about 8 feet high. Cottonwood is generally distributed along the streams in the medium and lower altitudes. Aspen is found almost everywhere below 6,000 feet, except in dense forests. Balm of Gilead occurs in the eastern foothills.

SIZE AND QUALITY.

Yellow pine, while thoroughly abundant in the Upper Swan and Clearwater valleys, is not as large and vigorous as in the lower and more fertile lands of the Flathead Valley, where it is sometimes 6 or 7 feet on the stump and 100 feet or more high. Within the reserve it is seldom more than 3 feet in diameter and 90 feet high. It is frequently fire scarred and otherwise defective.

White pine is seldom sound, and in addition to the common dry rot, much of it is dying. The dead trees are almost worthless for timber.

Lodgepole pine, one of the hardiest trees, while seldom more than 20 inches on the stump and 100 feet high, is usually straight, sound, and comparatively free from large knots.

Nut pine, while hardly to be considered for log timber at present on account of its inaccessibility, is sometimes large enough for saw logs, and may possibly be in future local demand.

Limber pine is remarkably crooked and knotty where exposed, as on the eastern foothills. On the mountain sides it is frequently found fairly straight and clear in sheltered places, reaching a diameter of about 28 inches and a height of 50 feet or more. Such good trees are exceptional.

A. UPPER SWAN RIVER VALLEY.

B. YELLOW PINE ON SHORE OF PLACID LAKE.

Engelmann spruce, besides having an even distribution, is the most useful tree. With lodgepole pine and red fir it forms the dense forest of pole timber on the exposed but well-moistened slopes, and with balsam makes large log timber in the higher gulches. Some trees about 34 inches in diameter and 125 to 130 feet high were seen.

Of white spruce, only a few small trees were surely identified.

Western larch, the most abundant timber tree of the valleys, like the yellow pine, is smaller than in the Flathead and Stillwater valleys. There it is about 4 feet in diameter and 180 feet high. In this reserve it is seldom more than 30 inches in diameter, none being seen over 3 feet, and it is seldom over 125 feet high. It is more knotty, but it seems to be quite as sound as in the lower country (Pl. XI, *A*).

Red fir becomes more defective to the eastward. It reaches out on the plains somewhat, but there, except in sheltered places, it is hardly able to raise an upright stem. In the foothills it is bushy. Ascending the mountains, it is found in some basins as large as 30 inches on the stump and 80 feet high, but so defective with dry rot that it makes very poor timber for the sawmill. West of the Continental Divide it improves both in size and quality, but is still subject to dry rot, and many dead stubs are found in the forest without evidence of fire or other very plain cause of their death. The most hardy trees are on rocky mountain slopes, where the roots can reach constant water, but such trees are isolated, short, and knotty, and seldom suitable for log timber.

Mountain larch, probably of no commercial importance, is found 15 inches in diameter and 70 feet high. Though not cut and carefully examined the trees seemed generally sound.

Balsam is never a large tree, at least none were seen more than 15 inches in diameter and 70 feet in height. It is usually defective in the butt and full of small knots.

Cedar is found 3 feet in diameter and 80 feet high, but this size is unusual. The tree was nowhere abundant, yet small areas of it occur, and it may be of some commercial value for poles, posts, or shingles.

Aspen is not notably different here from the aspen of other regions. It is occasionally large enough for log timber, but is seldom over 10 inches in diameter and 60 feet high. Where much exposed it is reduced to mere brush.

The other trees, silver fir, hemlock, cottonwood, and balm of Gilead, are small and so isolated as to be of no commercial importance.

ESTIMATES.

Any attempt to estimate 4,800 square miles of very irregularly patched and broken forest in four months must have a somewhat unsatisfactory result. While the closest estimates are expected to come within 10 per cent of the actual amount, these can only be hoped to lie within 50 per cent, but they are all believed to be less than the actual amount.

These estimates are made on the basis of practice in the Lake States, viz, estimating as log timber every stick that will make a log 12 feet long, 6 inches in diameter at small end, and scaling two-thirds of a full scale.

In making the estimate it was of course necessary to pass many square miles by with only a cursory view from a mountain or hilltop. Small representative areas were examined in detail, and on these the general estimate was based. These estimates are as follows:

Estimate of timber in Lewis and Clarke Forest Reserve, Montana, by areas.

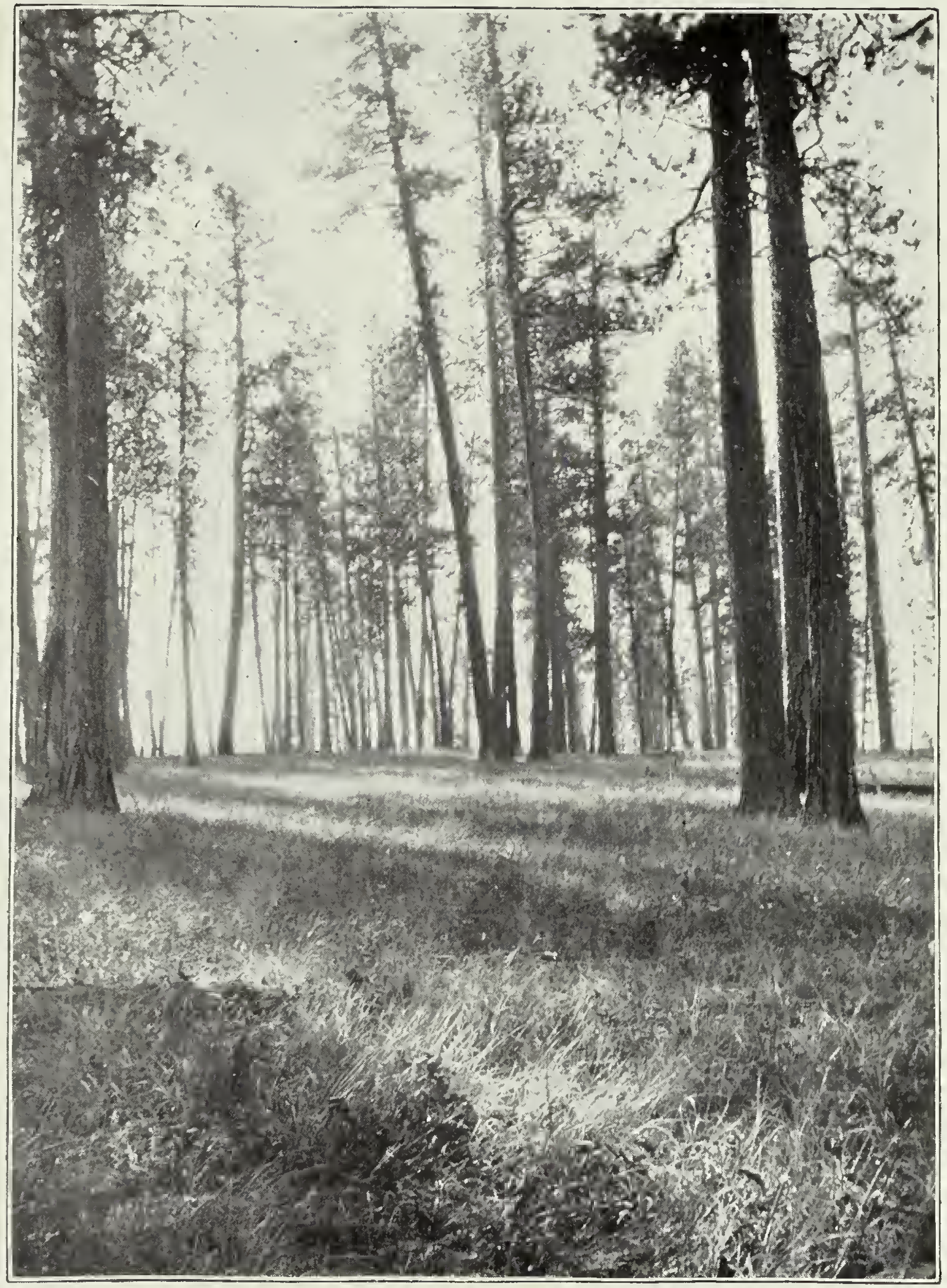
Locality.	Feet B. M.	Cords.
Eastern slope	63, 000, 000	1, 579, 000
Middle Fork of Flathead	154, 000, 000	1, 500, 000
South Fork of Flathead	442, 360, 000	5, 130, 000
Swan-Clearwater	1, 985, 000, 000	4, 660, 000
Total	2, 644, 360, 000	12, 869, 000

Estimate of timber in Lewis and Clarke Forest Reserve, Montana, by species.

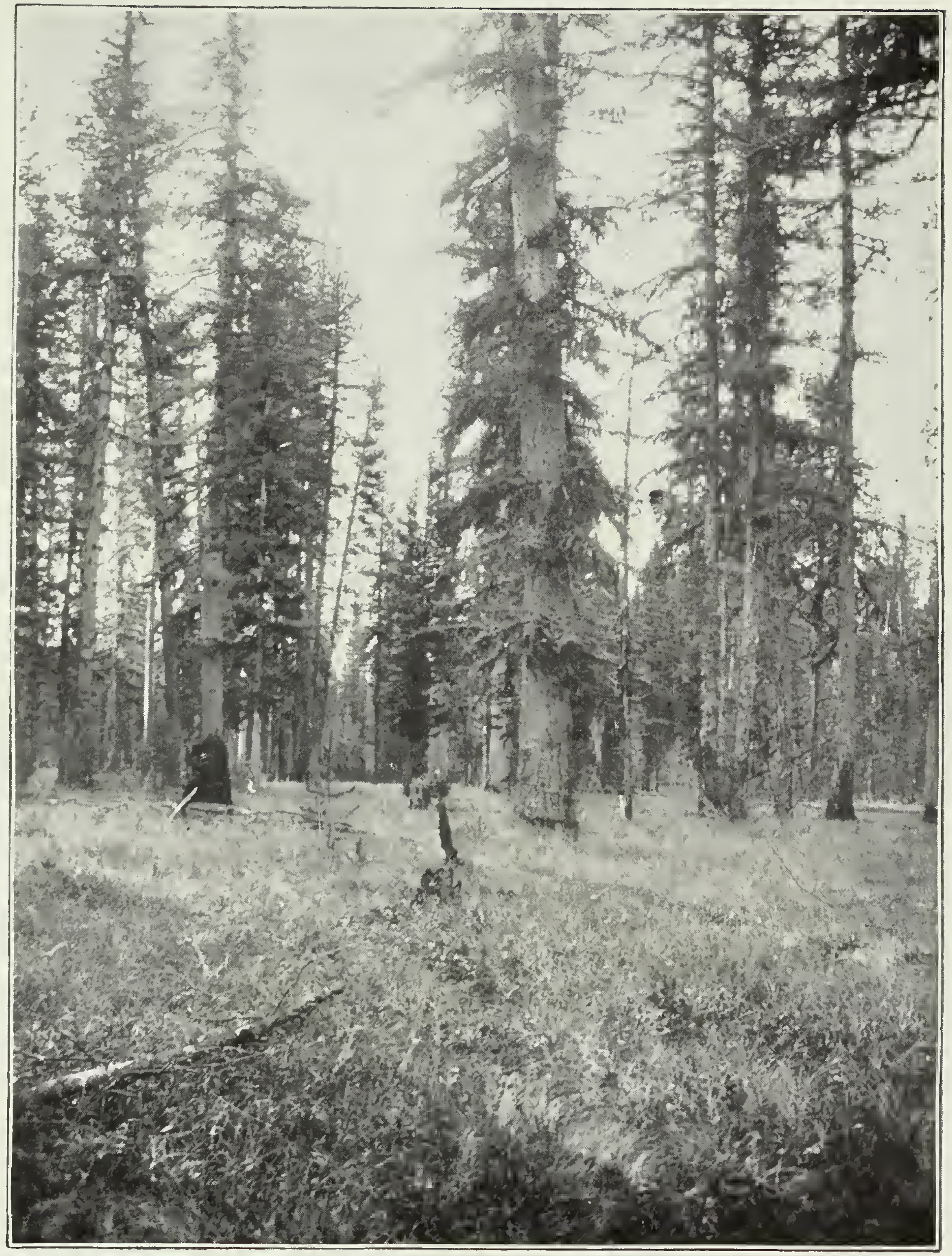
	Feet.
Larch	1, 265, 444, 000
White pine	26, 547, 200
Yellow pine	235, 388, 800
Red fir	647, 690, 000
Spruce	350, 622, 000
Lodgepole pine	118, 668, 000

YOUNG GROWTH.

On the areas shown as recently burned the young growth is quite small and has been described under the head of reproduction. On the older burns it is common to find a dense stock of saplings; but these, as a rule, are principally lodgepole pine, especially on the slopes east of the Continental Divide. Engelmann spruce and red fir have made their appearance on some of these old burns, but rather subordinate to lodgepole pine. In rapidity of growth they are inferior, and in numbers they constitute but a small proportion of the new forest.



A. LARCH, YELLOW PINE, AND RED FIR, WITH SPARSE SEEDLINGS.



B. YELLOW PINE FREQUENTLY AND LIGHTLY BURNT.

A. MILL ON SMITH CREEK, SOUTHWEST OF HAYSTACK BUTTE.

B. DEADWOOD PARTLY CUT, SOUTH FORK OF TETON CREEK.

On the tracts that have been unburned for many years seedlings have sprung up as the old trees have died and fallen, so that these old forests are composed of trees of all ages, and in them the saplings too small for log timber constitute a very important factor to be considered in forest management. In many cases the mature trees may be cut out for lumber and the saplings left will be a sufficient stock, partly grown, for a new harvest of logs. By carefully marking the trees to be cut and by using care to preserve this young stock, the continuity of the forest may be unbroken by logging operations.

In this old forest the young growth is apt to have a large proportion of spruce and a small proportion of lodgepole pine, as the shade of the old trees is favorable to the starting of spruce, but unfavorable to the pine. Next in proportion to spruce, red fir is common, and in the more open places balsam follows next in order, while larch and lodgepole pine choose the spots that are most free from underbrush and grasses. Yellow pine seems to come in only on lands that have bare earth.

The areas having old mixed forests with a fair stock of young growth are very few on the eastern slope, except in some of the smaller valleys near the Continental Divide. Such areas occur on the headwaters of the Middle Fork and on the western tributaries of the North Fork of Sun River; also on the Middle Fork and on the lower half of the South Fork of Flathead River. The lower portion of the Swan River Valley, although considerably scarred by fires, has much of such forest still remaining, especially in the tributary gulches. The upper portions of these valleys have been overrun by moderate fires that have thinned the forest, and while most of the land is restocked, the seedlings are seldom over 10 feet high.

UNDERBRUSH.

The principal species of brush are alder, willow, dogwood, buckbrush, waxbush, yew, squawberry, service berry, brittlebrush, and juniper. Beside these shrubs, some of the trees often grow in such a manner as to practically form an underbrush in the forest, especially after a light fire that has not seriously thinned the forest, yet has permitted seedlings to start.

In general, the underbrush is not dense. With the exception of some of the damper ravines where yew abounds, the brush would offer no serious difficulty to taking horses anywhere, unless through the aspen thickets on the eastern slope (see Pl. XI, *B*).

Brush is most abundant, perhaps, in the valley of the Middle Fork and in the lower portion of the valley of the South Fork of Flathead River and in the lower portion of the Swan River Valley.

In the higher altitudes, especially where exposed, balsam and spruce, and east of the Continental Divide limber pine, are frequently matted close to the ground, forming dense but small impenetrable thickets, although they are tree species.

Except where kept in subjection by light fires brush is usually abundant enough to be a serious hindrance to logging operations and to prevent the ready starting of seedlings.

CUTTING.

There are three small sawmills within the reserve, one on the South Fork of Depuyer Creek, another on the South Fork of Teton Creek, and a third on Smith Creek, southwest of Haystack Butte (Pl. XII, *A*). The logs for these mills are taken from the mountain sides or the basins above them.

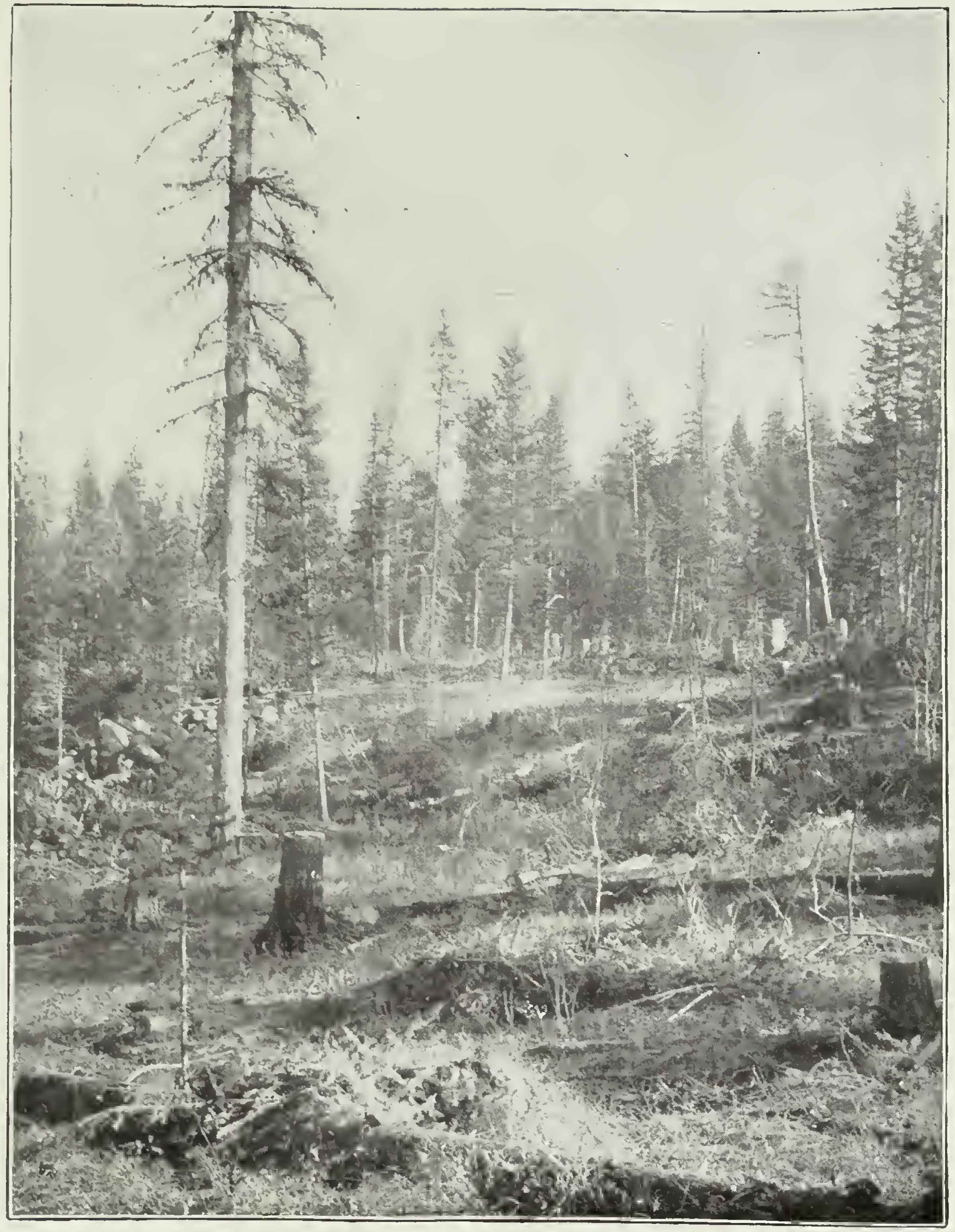
For the mill first mentioned the logs are twitched down the mountain side to the stream, then floated with great difficulty about 2 miles through the canyon to the mill at its mouth. Some 300,000 feet B. M. have been cut in the valley of the South Fork of Depuyer Creek. This timber was spruce, red fir, and lodgepole pine.

The second mill is near the head of the South Fork of Teton Creek, about 6 miles from the plains. The logs are being taken from the mountain side near the mill and are almost entirely spruce and lodgepole pine. On the forks of Teton Creek are several old mill sites, and, roughly estimated, a million feet B. M. have been cut on the South Fork and 600,000 feet on the North Fork.

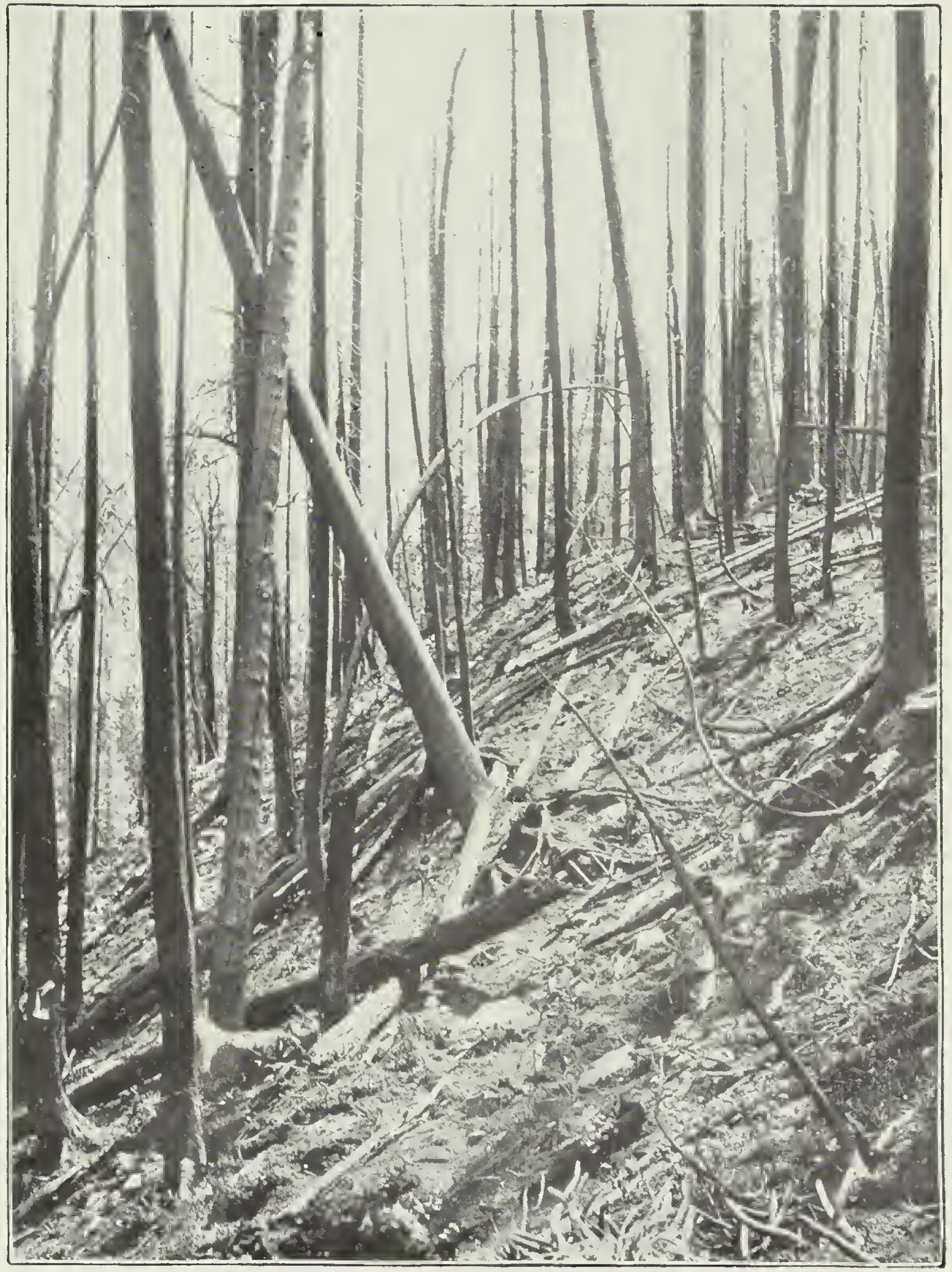
The mill on Smith Creek, but a short distance within the reserve line, is cutting logs from the high mountain side south of the headwaters of the stream. The logs are dragged with much difficulty and some danger about 2 miles down the steep slope. The timber used is lodgepole pine and spruce. There is little red fir in the basin. About a million feet B. M. of all kinds have been cut in this valley.

Besides the log timber cut east of the divide, some 300,000 railroad ties have been cut and floated down to the Helena branch of the Great Northern Railway. Some 200,000 of these were cut on the North Fork of Sun River and approximately 100,000 on Dearborn Creek.

All along the eastern front of the mountains the people from the treeless plains get fuel, house logs, and poles for fences and corrals. Almost every little valley that is wooded and that is reasonably accessible has a well-used wagon road leading into the timber. The people come and cut the timber as they need it, loading it immediately upon their wagons without leaving any amount cut and lying upon the ground, even over night. Ranchmen, as a rule, bring their own teams, but for village supplies there are half-breeds living among the foothills who make a business of taking out the wood and selling it. A colony of these woodcutters was found on the South Fork of Teton Creek (see Pl. XVIII, *B*), another on Smith Creek, and another on Dearborn, near the mouth of Falls Creek. Altogether about 62,000



A. CUTTING AND SKIDDING ON PLACID CREEK.



B. BURN OF 1889, UPPER DEARBORN RIVER, 3 MILES EAST OF PTARMIGAN PEAK.

cords of fuel, house logs, and fencing have been cut on the eastern slope of the mountains.

Along the Great Northern Railway there has been a great deal of cutting for bridge timber and ties, and besides some material has been taken for fuel, cribbing, tunnel timber, wagon bridges, and corduroys. The construction camps also have taken a large amount.

On account of lack of time no attempt has been made to estimate the amount of this material. It is said that all or nearly all the bridge and tie timber used in the construction of the railway through the mountains from Columbia Falls to Midvale was taken from the woods along the line.

Elsewhere on the reserve the only cutting has been for the cabins of prospectors, hunters, and trappers, and the few squatters in the Swan-Clearwater Valley, and for trails or camp use.

The logging operations of the Blackfoot Milling Company, on the Clearwater drainage, have worked up to but have not cut over the south line of the reserve. The logs are floated down Blackfoot River (see Pls. XIII, *A*, and XV, *A*).

FIRES.

Extent.—Only the areas recently burned, or those overrun by fire within the last forty years, have been shown on the map. The older ones have lost the characteristics and the features of burns that make them noticeable in the distant view necessary in mapping them. They have either become barrens or have been restocked with trees. A considerable but undeterminable portion of the mountain ridges shown on the map (Pl. III) as bare or destitute of forest has been made so by fires that have exterminated the stunted forests which were just able to exist under the severity of climate without the fire.

Many of the eastern foothills now grassed prove upon close examination to have been once wooded; for here and there upon them old charred roots and stumps are found. The fire lines on the map can be drawn only approximately, for the effects of fire often fade out with an impreceptible border.

Roughly estimated, the recently and severely burned areas within the reserve are as follows:

Areas recently burned in Lewis and Clarke Forest Reserve, Montana.

	Square miles.
East of the Continental Divide	600
Middle Fork of Flathead River	95
South Fork of Flathead River and the Blackfoot drainage	485
Swan-Clearwater Valley	240
Total	1,420

In addition there are, as shown on the map (Pl. III), outside the reserve the following burned areas:

Areas recently burned adjacent to Lewis and Clarke Forest Reserve, Montana.

	Square miles.
Along the Great Northern Railway	134
East of the reserve line	40
South of the reserve line	206
Total	380

This, added to the 1,400 square miles within the reserve, makes a total of 1,800 square miles of recently burned forest shown on the map.

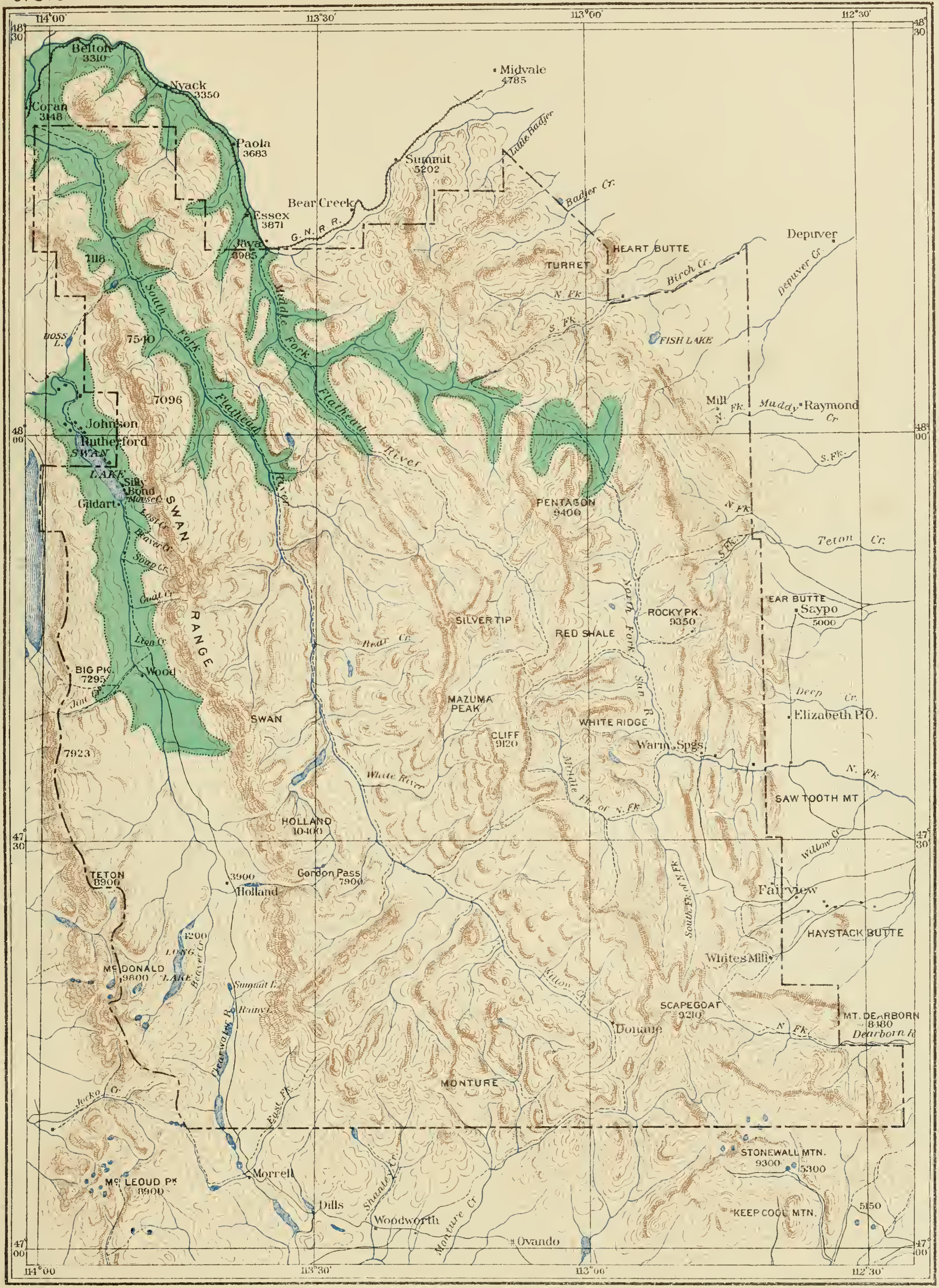
Causes of fire.—While some of these fires have no doubt been caused by lightning, nearly all have been due to carelessness on the part of men. The causes of fire may be grouped into four classes: First, those originating directly or indirectly from the railroad; second, those running in from the prairie; third, those escaping from settlers on the borders of the forest; fourth, those caused by Indians, hunters, and prospectors.

The greater area, probably some 1,200 square miles, was burned during 1889. That year is said to have been exceptionally dry, and the smoke from the forest fires almost unendurable. At that time the Great Northern Railway was being built across the mountains, and the great number of men employed in its construction, and the many prospectors and claim hunters attracted by the opening of the country, made a combination of circumstances very favorable to the starting of fires.

About forty years ago, also, many fires occurred. Most of the burns of that time have been reburned since. Where not repeated, they have either been covered again by forest or they have become mountain barrens.

Intensity of fires.—On most of the burns mapped the fires have been severe enough to kill all, or nearly all, the trees and to consume the humus (see Pls. XIII, *B*, and XV, *B*). The borders of the burns are generally sharp and well marked. But many light fires have also occurred; these have crept over extensive areas, killing brush and the smaller and tenderer trees.

The fires have varied through all degrees of intensity. The severest have rushed through the tree tops consuming the needles and smaller twigs and igniting the humus lying upon the surface, which, even when burning slowly, has made fire enough to consume the smaller roots that were in the humus. The fires of 1889 were generally of this sort. Many other fires have occurred, doing much less damage to the forest. Creeping slowly along, they have killed much of the vegetation and even some large trees, but the lightest of them have merely thinned the forest, injuring many trees, but still leaving many seed trees and a favorable surface for seeds to start.



JULIUS BIEN & CO. N.Y.

LEWIS AND CLARK FOREST RESERVE
MONTANA
Showing distribution of cedar, hemlock, white pine and silver fir
Prepared under the direction of Henry Gannett, Geographer in charge
BY H. B. AYRES

Scale
5 0 5 10 15 20 25 30 Miles
Sketch contours
1899

Damage by fires.—The damage done by fires might by some be estimated as nothing because the timber had no market value at the time, but by the community and the State it should be viewed as an injury to a great natural resource. While the timber trees, the saplings, and the seedlings killed had no immediate market value where they stood, they had a future value which has been destroyed. In addition, the fires have postponed the possibility of again having such a forest on much of this land within one hundred years, and on some of it a very much longer time, for the fires have consumed the product of centuries in humus, shade, shelter, and other necessaries for the germination and growth of seedlings. These higher regions are now frequently found barren, or lightly covered with grass or mountain plants, with a few roots and stubs remaining as proof that a forest was once there.

Deadwood.—The amount of material standing dead is roughly estimated as follows:

Deadwood standing in Lewis and Clarke Forest Reserve, Montana.

	Cords.
Missouri River drainage	200,000
Middle Fork of Flathead River, within the reserve	100,000
Middle Fork of Flathead River, outside the reserve	150,000
South Fork of Flathead River	600,000
Swan-Clearwater Valley, within the reserve	128,000
Total	1,178,000

No effort was made to estimate the material that is down. It is not marketable and never can be until made accessible immediately after falling, as where logging and woodcutting are being carried on.

Reproduction.—The burned areas east of the Continental Divide and those of the valley of the Middle Fork of Flathead River are very scantily restocked, having little else than small lodgepole pine in strips and groups, usually near the unburned forest.

In the valley of Willow Creek (South Fork drainage) there is a dense stock of lodgepole pine coming up through the network of fallen trees.

The same condition prevails in the region about Spotted Bear, while on Hungry Horse the old burn has a very scant stock.

In the valley of Swan River the "Big burn," about 6 miles below Holland's ranch, has enough lodgepole pine to cover it in about twenty years.

The burn on Crow Creek Pass is principally occupied by brush, but has a sprinkling of spruce, lodgepole pine, and balsam.

The large burn on the mountain west of Swan Lake has a scanty stock of spruce, balsam, and lodgepole pine.

The upper portion of Swan River Valley has a dense stock of lodgepole pine and larch under the larger larch that has survived several incursions of moderate fires.

The burns on other mountain ridges, so far as stocked at all, have a mere sprinkling of nut pine, Engelmann spruce, and balsam.

The stock on lightly burned regions, as a rule, is not only mixed as to species, but also as to size. There are some areas on old burns which are occupied by lodgepole pine only, but these are the exception and are not large.

Liability to fire.—Until the appointment of forest rangers there had been no steps to prevent the starting or the spread of fires except the carefulness of those likely to cause them. During the season of 1899, however, no fires were found burning, though several had been extinguished by the forest rangers, who patrolled the trails and kept themselves posted as to the movements of persons within the reserve. Along the railroad the greatest danger of fires is from locomotive sparks, though they are liable also to be started by trackmen burning rubbish. East of the mountains the danger is from fires sweeping in over the prairie or from the lunch fires and smudges of the woodcutters who come from the plains. In all the mountain area the camp fires of prospectors, trappers, tourists, and sportsmen are a constant menace.

Effect of fire on composition of forest.—The severe fires below 6,000 feet have been followed by lodgepole pine where restocked at all (see Pl. XVI, *A*), but the moderate fires in the lower altitudes and all those in the higher altitudes have usually been followed by a mixed growth in which spruce predominates. Many of the severe old burns that have been restocked have first been covered with lodgepole pine, under which spruce, white pine, larch, balsam, and other shade-enduring trees have sometimes started. A very dense stand of the original stock, however, does not readily admit other species, and lodgepole pine in such cases is apt to remain until the trees begin to die of old age (see Pl. XVII, *A*).

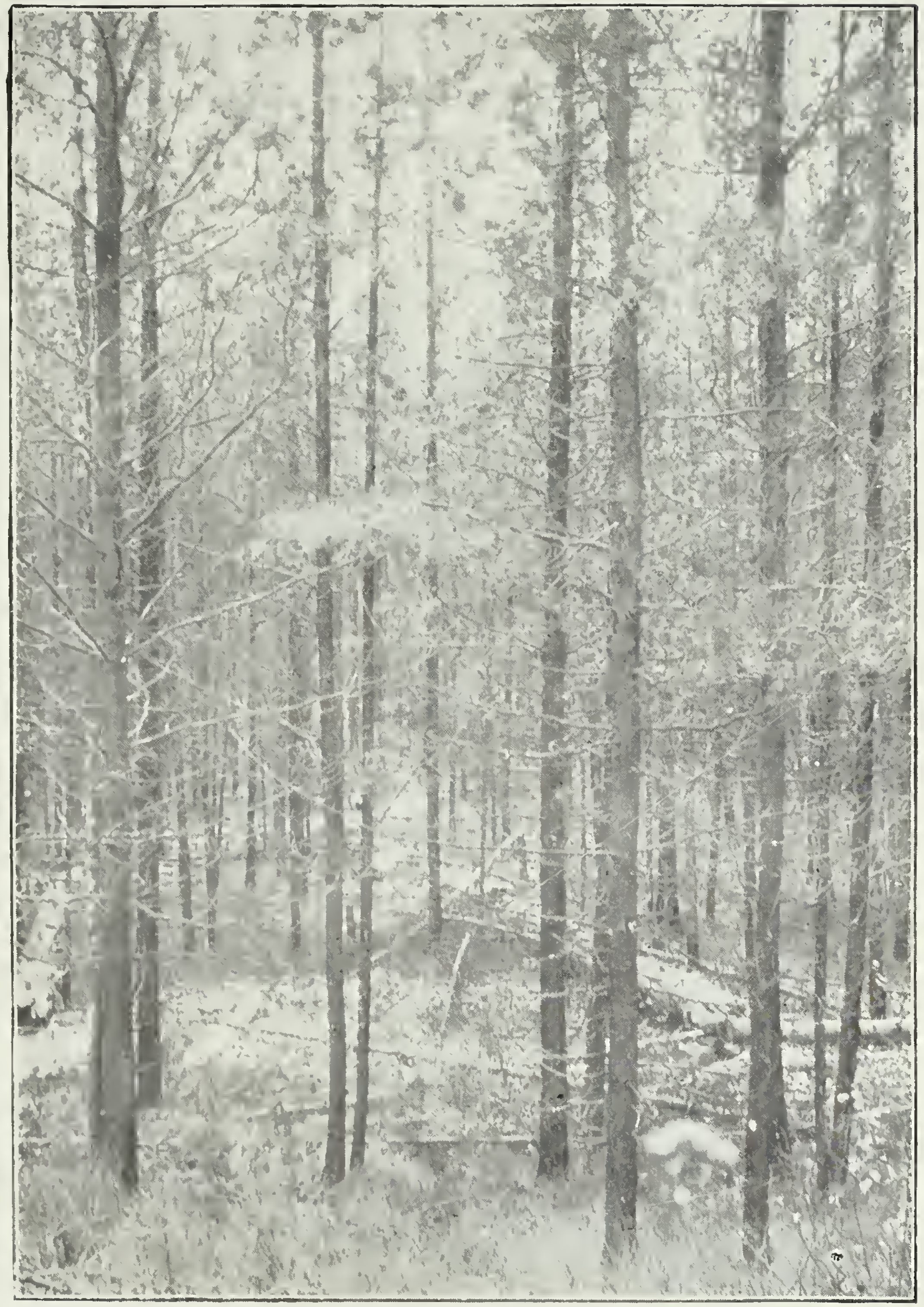
Moderate fires may thin out the species most sensitive to fire and leave those protected by thick bark. A notable instance of this was found in the upper portion of the Swan River Valley, where a mixed stock of larch and lodgepole pine had been run through by light fires, which killed the thin-barked lodgepole pine, but left the thick-barked larch but slightly injured. On looking over this valley from the mountain side in October, when the leaves were colored, the upper half of the valley seemed almost entirely wooded with larch.

RATE OF GROWTH.

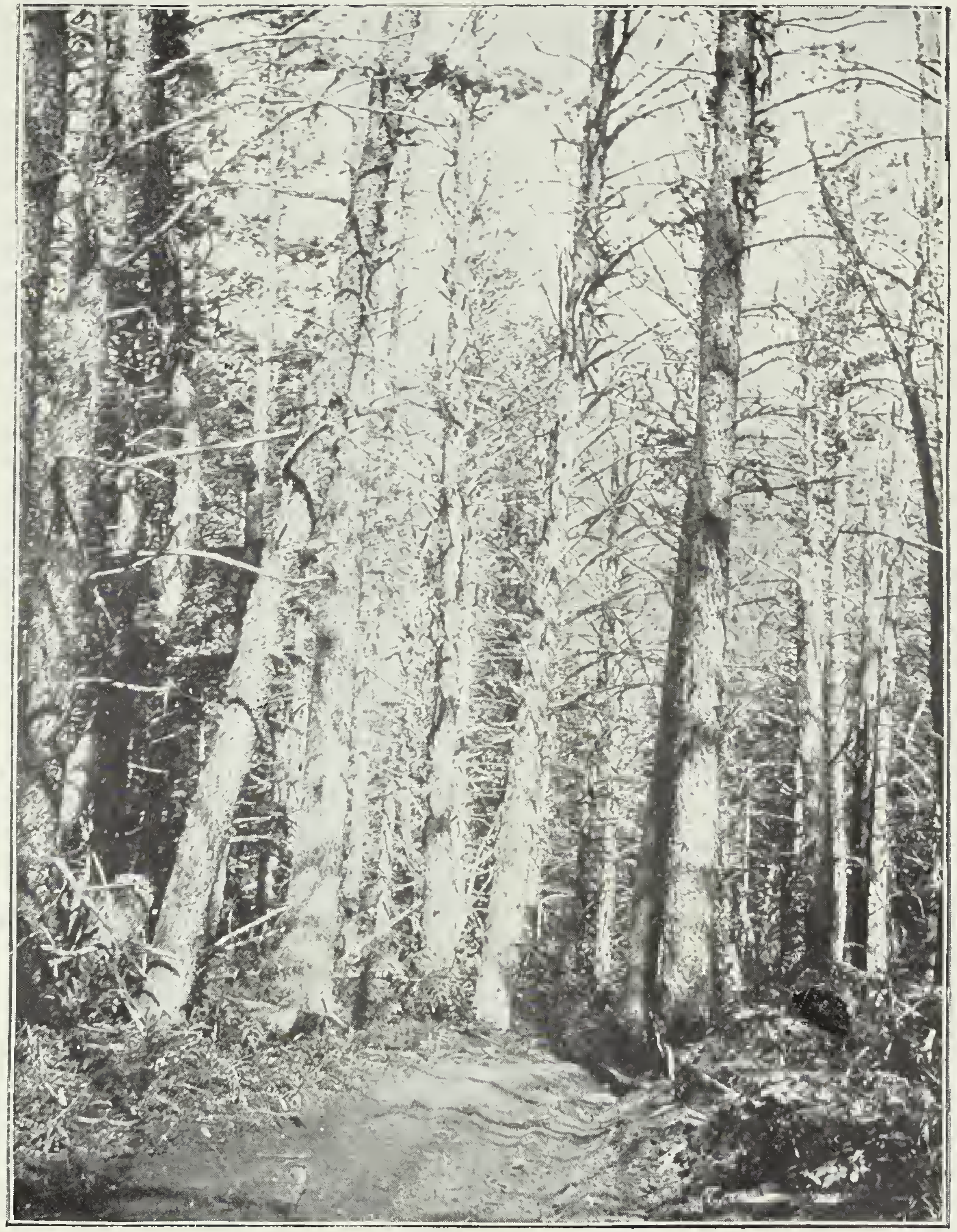
The rate of growth varies greatly not only according to soil and moisture, but also according to exposure and the influences of surrounding vegetation. The average increase on the stump in the lowland was found to be about an inch in ten years, accompanied by a proportionate growth in height.

A. DAM ACROSS OUTLET OF PLACID LAKE.

B. NUT PINE (PINUS ALBICAULIS) KILLED BY FIRE, SOUTH END OF WHITE RIDGE, NEAR MIDDLE FORK OF SUN RIVER.



A. LODGEPOLE PINE FOLLOWING LARCH AND YELLOW PINE, KILLED BY FIRE.



B. GROUP OF RED FIR (PSEUDOTSUGA TAXIFOLIA) PROBABLY KILLED BY DROUGHT.

Ascending the mountains, the rate diminishes until, near the line of perpetual snow, the annual rings are sometimes so thin as to be invisible to the naked eye. Height growth is especially slow in exposed situations, where even the hardiest species, as spruce and balsam, are compelled to lie matted on the ground without being able to form an upright trunk. The rate of accretion on the stump of open-grown trees in the lowland is sometimes one-fourth of an inch in one year, while densely crowded trees, especially those overtopped, may have only one-hundredth of an inch in one year.

The rate varies with the species also, larch being one of the most rapid-growing trees and lodgepole pine one of the slowest. The average rate seems less than in the forests of the Lake States. Here a crop of timber trees can hardly be expected in less than one hundred years, even on the most favorable portion of the lowlands.

ACCESSIBILITY.

Along the eastern slope of the mountains there are few streams that are practically drivable for log timber, possibly only Sun River and Dearborn Creek, but Birch and Badger creeks may prove drivable with some expense. The timber on most of the streams must be hauled out when cut. The question of transportation, however, will probably be how to reach the local market, as the treeless plains immediately east of the mountains could consume all the timber this slope would produce, with the exception of the Sun River Valley. This stream being easily drivable would afford fair transportation to the more distant or general market.

The valley of the Middle Fork of Flathead River has its only outlet by the way of Java, on the Great Northern Railway, and the river would afford the most feasible means of transportation, as it would be drivable at moderate expense. Should a permanent system of lumbering be established in this valley an electric railroad would perhaps be desirable to take supplies up the river, and possibly even to haul up empty cars on which logs could be taken down, perhaps in successful competition to river driving.

The valley of the South Fork of Flathead has also an outlet to the north, and the river may possibly be made drivable, although there is some doubt on this point, owing to the crookedness of several box canyons. It would be somewhat difficult to construct a railroad in this valley, because of many deep ravines cutting through the bench land.

The valley of the headwaters of the North Fork of Blackfoot River, continuous with this valley and separated from it by an almost imperceptible divide, has so little timber that the question of transportation need not be considered immediately. The valley of Willow Creek and the headwaters of the North Fork of the Blackfoot have a very smooth bottom and railroad grading would be very easy.

The tributary valleys of the South Fork of the Flathead are more difficult of access, and it seems probable that chutes and flumes may be the best means of getting the material out to the main valley.

The Swan-Clearwater Valley, at least between Clearwater Lake and Goat Creek, can probably be worked best by a logging railroad, as the streams have many gravel bars and many places where logs would float out into the brush during high water. Logs put into Swan Lake could be easily driven to Flathead Lake, a favorable point for manufacturing.

The divide between the Swan and the Clearwater valleys is a low one, and offers no serious obstruction to a railroad if it should be found desirable to take logs over from Swan River to the Blackfoot.

Throughout the reserve are large areas on the mountain sides that can be logged only by means of chutes.

MARKETS.

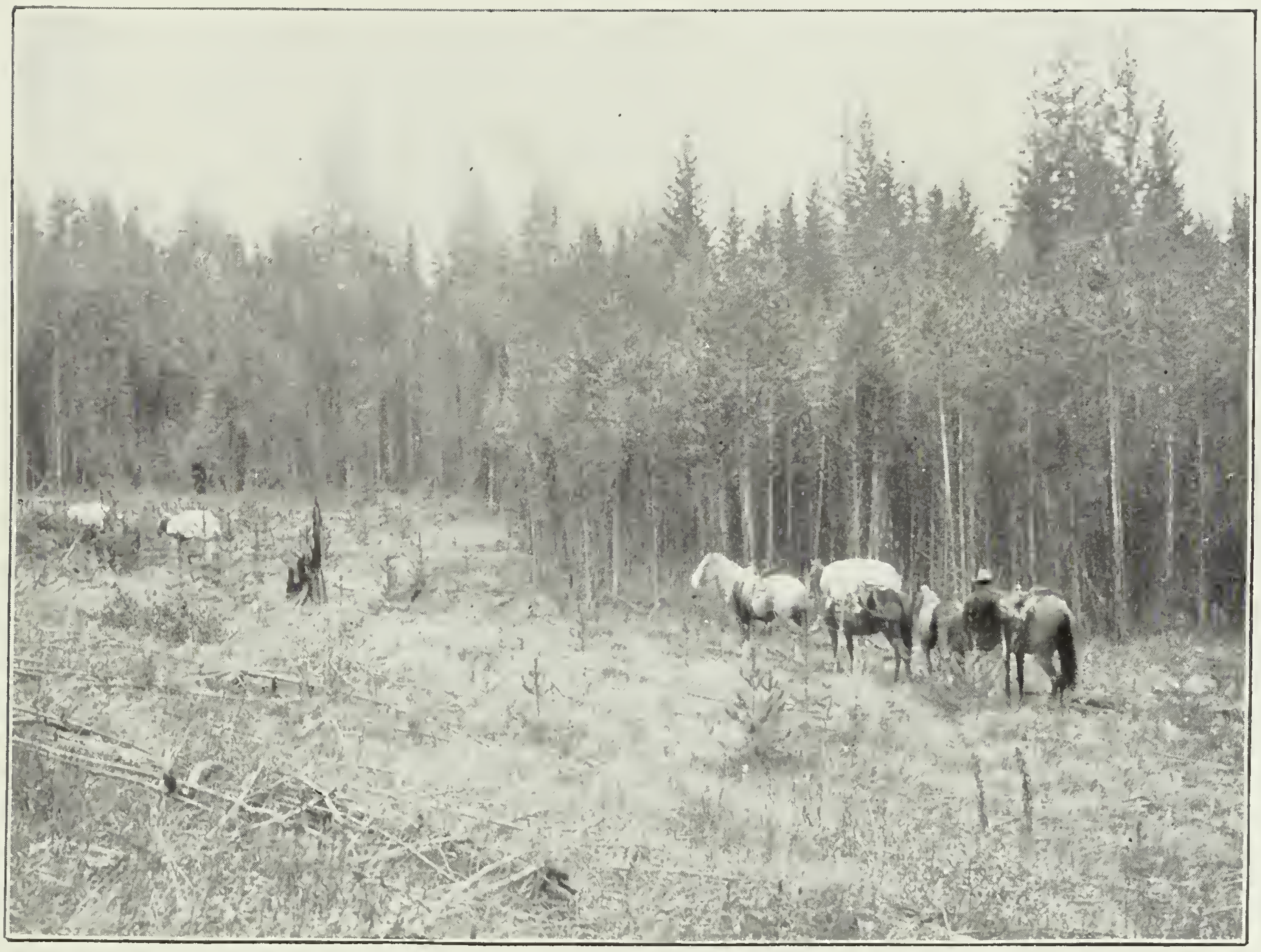
At the small mills east of the mountains rough sawed lumber brings $16 per thousand feet, and the deadwood is worth 25 cents a cord on the stump at Midvale, and would, doubtless, command that price all along the range southward. Log timber east of the range should be worth $1 per thousand feet on the stump in the more accessible regions, but quite a large proportion of it, possibly 50 per cent, has no value because of difficulty of access.

West of the Continental Divide probably nothing within the reserve has a market value to-day, owing to the difficulty of transportation. Improvements to make the timber accessible would doubtless be profitable at once in the Swan River Valley, and capitalists able to make these improvements could probably afford to pay a moderate stumpage value on the standing timber.

Outside of the reserve, along the Great Northern Railway, the mountain slopes, though steep and rocky, are fairly accessible, and the material on them should have a slight stumpage value under a thorough system of cutting and marketing.

SUGGESTIONS FOR MANAGEMENT.

Considering the configuration of the land, the isolation of the valleys, the liability of fire, the difficulty of two or more operators working in the same valley, the benefit to the operator of having control of a definite area and also of the means of transportation leading to it, and the advantage of having one person responsible for fires or depredations in a single district, it seems advisable that the right to cut in each valley be leased entirely to one person, and that the lease be made for a long time. This person could then improve the stream, make flumes or roads, establish a permanent mill plant, and carry on his business in conformity with a system of forestry that should, of course, be decided upon before the lease is made. Under such a system of leases there would be an opportunity both for small and large operators.



A. EFFECT OF REPEATED FIRES.

B. EAST SHORE OF SWAN LAKE, NEAR BOND'S.

The small valleys east of the Continental Divide would be suited to those only who run small mills and who would sell their sawed lumber at the mill to people from the plains, and who would handle fuel and fence poles as well as log timber.

The timber west of the divide must seek a more distant market, as there is not now, and probably never will be, any great local demand. The management of these lands should conform to the necessity of such operators as could manage them.

REGULATIONS SUGGESTED FOR CUTTING.

A mere restriction or limitation to certain sizes, such as permitting only trees over 12 inches in diameter to be cut, while perhaps a convenient rule for loggers to work by, would be very injurious to the forest. In fact, a forest could hardly be in worse condition than this rule would bring about. The forest needs thinning, but this regulation would not accomplish that object. As the forest stands now there are patches of large trees and patches of small. Under this rule the tracts of large trees might be cut clean, while the patches of small would be left untouched, however much they might be in need of thinning. This is found to be the effect under the present system, and such a rule would not make any material change in the custom. The thing to be done is to provide a market for both large and small material and have the trees to be cut marked, so that while getting out marketable material the condition of the forest may also be improved, and after logging is over be left in as good or even better growing condition than it was before.

MINING.

No ore is being shipped from the reserve at present. A few copper and silver claims are held on Smith Creek, and a few on the lower portion of the South Fork of Flathead River. At the "coal banks," about 25 miles above the mouth of the river, a tunnel has been driven in the bank of the river along a bed of lignite coal.

CLIMATE.

There are very great differences of climate between the bleak and frosty alpine summits and the sheltered canyons above 5,000 feet. The dwarfed trees on the mountain ridges show the effect of cold weather, frequent storms, and lingering snow, although in sheltered canyons or gulches a short distance away they may be growing luxuriantly at the same altitude.

There is also a marked difference in the climate east and west of the mountains. During the severe storm or blizzard, with deep snow fall, that raged on the plains about the middle of October, there was in the Swan River Valley only a moderate amount of wind and only about 6 inches of snow. While a temperature of about 20° below zero was reported from the plains, in the Swan River Valley it was little below freezing.

A corresponding difference was found in the vegetation. Certain species which love moisture and are unable to endure much exposure are found in the western valleys, but do not appear east of the Continental Divide. Among these are larch, white pine, cedar, hemlock, and yew. Some of the higher ridges east of the Continental Divide seem to have been wooded with a stunted growth of alpine trees. Now a few pieces of pitchy roots are found on the rocks above the present timber limits. Such places were noticed on Birch and Deep creeks, and on the ridges about the headwaters of Ford Creek. This suggests that the climate may be growing drier. The great number of red fir found dead on the eastern slope in places most subject to drought indicates the same thing. On the South Fork of Depuyer Creek, where some cutting has been done in a mixed forest of red fir, Engelmann spruce, and lodgepole pine, the mountain side was patched with areas of dead, or half-dead trees (see Pl. XVI, *B*). One of these areas was found along a skidding trail, worn to a depth of 2 feet below the surface. Walking along this trail it was noticed that among the dead trees the bottom of the trough was dry and hard, while among the adjoining live trees it was moist. The dead trees were not older than the living, and no other cause could be found for their dying than the fact that the ground where they stood was drier than that on which the living trees stood.

OCCUPANCY.

Most of the land occupied by squatters east of the Continental Divide is on the plains, in the angle south of Birch Creek. These squatter claims were not all located in passing. There are probably 6 or 8 in this angle (see Pl. XVIII, *A*). If the reserve line were drawn close to the foot of the mountain these would be excluded.

On Ford Creek a ranch and a herder's cabin were seen. The ranch is not far within the reserve line. About the ranch are some 30 acres under cultivation, and the owner of this ranch, in company with others, had some 500 cattle and about as many sheep grazing on the hills about the headwaters of the stream.

On Sun River, the ranches of Wagner and Hannon are well within the reserve. Wagner has a log house, barn, and pasture fence. Hannon, on Storehouse Creek, has some 20 or 30 acres in meadow, with house and outbuildings and several fences across the lower portion of the valley. He has some stock. Thirty of his horses were found grazing on the North Fork of Sun River.

On Teton Creek, McGurk's mill, and on Smith Creek, White's mill lie within the reserve, and about them are clustered several houses occupied by the employees.

A. HOUSE OF A SQUATTER ON THE RESERVE.

B. COLONY OF HALF-BREED WOODCUTTERS ON SOUTH FORK OF TETON CREEK.

A. HOLLAND'S RANCH, UPPER SWAN RIVER VALLEY.

B. CUTTING LODGEPOLE PINE.

On Dearborn Creek, near the mouth of Falls Creek, and on the South Fork of Teton Creek are groups of cabins occupied by half breeds, who cut wood on the reserve and haul it out to market on the plains (see Pl. XVIII, *B*).

A lime kiln is being operated by Mr. C. V. Clemens near the mouth of Falls Creek.

On the South Fork of Depuyer Creek, Alex. Yule has a sawmill at the mouth of the canyon, and above the canyon has several houses occupied by his loggers.

On Willow Creek, or the east branch of the South Fork of Flathead River, Mr. James Donahue has a stock ranch and about 100 head of cattle and horses. A few cabins, built by trappers or prospectors, were seen here and there in passing down the valley.

At the coal banks, Batti's cabin was found occupied, and a few miles above this, on a branch of the main valley, there are prospectors' cabins occupied at times.

In Swan River Valley are several squatters about the head of Swan Lake, but they have few improvements except their houses. Between this and Hollands there are about 10 log houses, all of them unoccupied.

Holland's ranch, at the mouth of Holland Creek, comprises several log houses and stables. Mr. Holland has several hundred acres fenced in, which he is using as pasture for cattle and horses (see Pl. XIX, *A*).

At the foot of Elbow Lake is a trapper's cabin, occupied at present.

On the Clearwater, Mr. Seeley, a forest ranger, has occupied a ranch at the head of the lake for several years. He has recently built a larger house, near the foot of the lake, and within about one-fourth of a mile of the reserve line.

FISH AND GAME.

All the waters of this region are remarkably full of trout, of which there seems to be several species. The most abundant are about a foot long and weigh from one to two pounds. Salmon trout were seen on the South Fork of Flathead River, the largest being 36 inches long.

East of the mountains large game has been hunted until a track is seldom found.

In the center of the reserve, however, are elk, moose, goats, sheep, black- and white-tailed deer, and the several species and varieties of bear common in the Rocky Mountains. Blue grouse are abundant, especially eastward. The common ruffled grouse are rare eastward, but abundant in the Swan River Valley. The fool hen is common everywhere in medium altitudes.

SCENERY.

This region, though not as alpine as the Flathead Reserve, has many high mountains and rugged hills.

There are a few glaciers, a small one at the head of Gordon Creek, one near McDonald Peak, and the Stanton Glacier, west of Essex, one of the largest in the range.

The peaks about the Stanton Glacier, Scapegoat Mountain, Turret Mountain, Silvertip, and Pentagon on the main range, three or four points on the Kalispell Range, and McDonald Peak on the Mission Range, are 8,000 to 10,000 feet high and afford excellent views, while the valleys, though much marred by fires, contain many attractive places. The opening of the trails by the forest rangers is rapidly making the region accessible by saddle and pack horses.

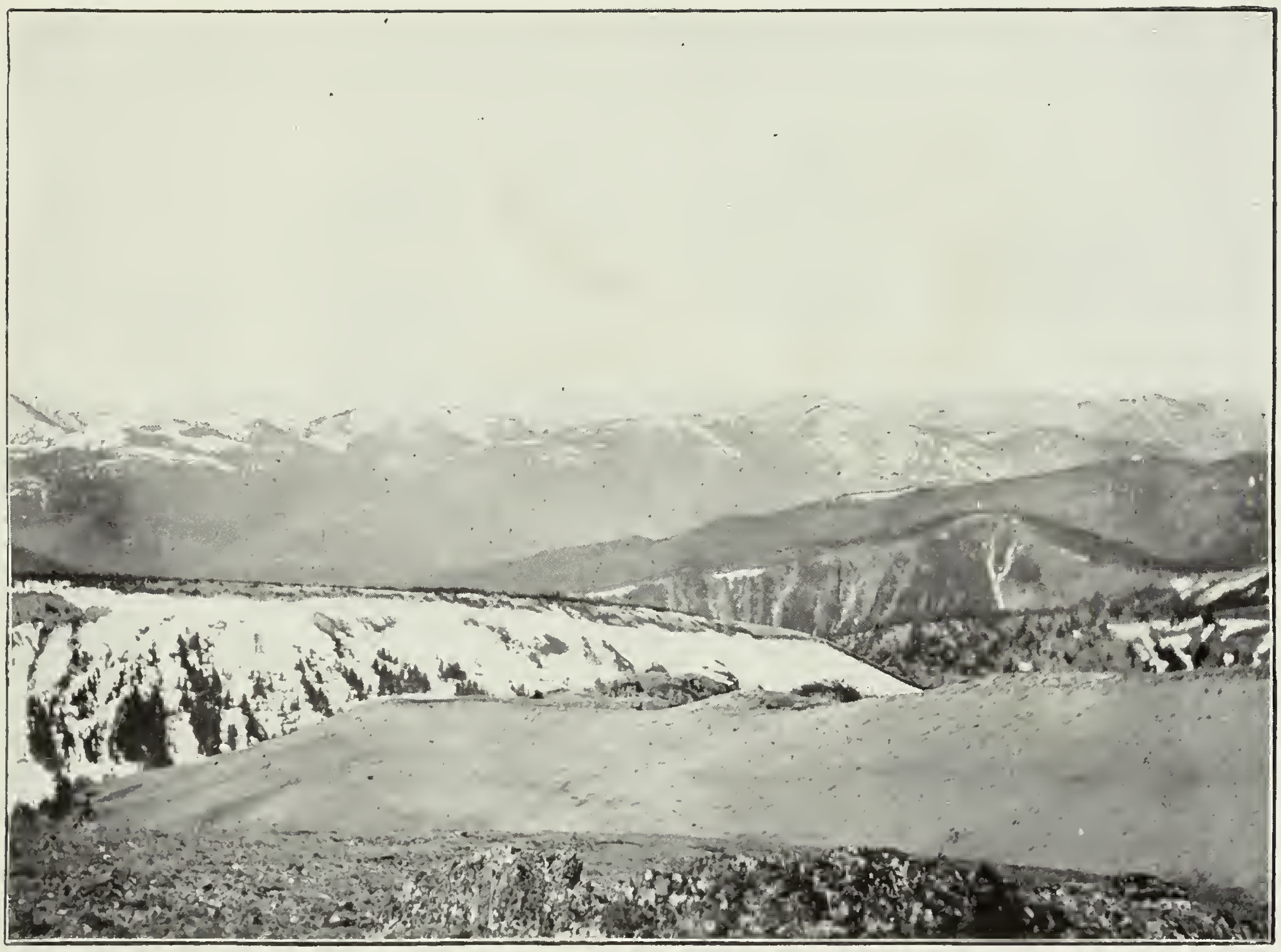
EXPLANATION OF MAPS.

It should be said, in explanation of the maps, that sharp lines on the maps for distribution of species and the limits of burned areas do not represent the actual condition in the forest. A blending of adjacent colors and a fading out toward the prairies and toward burns would, in most cases, represent the actual condition far better, but as it would be impossible to print such a map the lines are drawn sharp, and are thus only approximately correct. The borders of light burns may actually be several miles from the lines shown on the map, because, creeping lightly over the surface, some of them do so little damage that the effect is not noticeable from a distance, and the line could only be mapped by the slow process of tracing its course with compass, and pacing through all its meanderings. A few of the borders of burns are found sharp and definite in the forest, but where they are not found well defined in the woods the line is drawn on the map as near as possible where half of the forest has been killed.

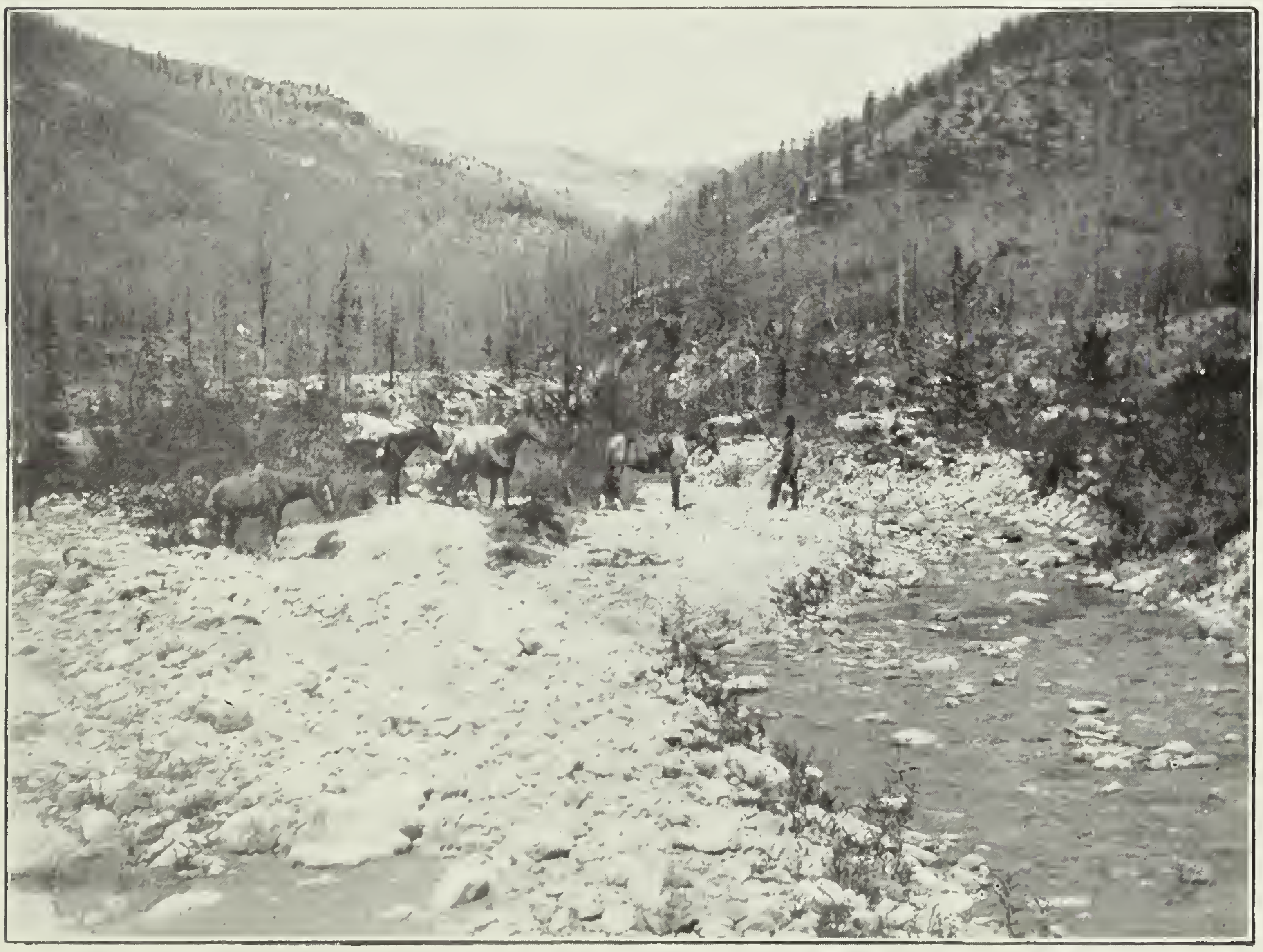
There was difficulty, also, in determining the lines on old burns that have been more or less restocked, and there may be many inaccuracies on this account. Where the dead trees of a burn are still standing the distant view of such a tract gives the impression that the line should be drawn at the border of the deadwood. This is approximately correct, because usually the deadwood falls before any young stock that follows could become large enough to be called a forest. Where young stock, 15 feet or more high, was found on old burns it was marked as forest.

In marking the distribution or habitat of species one never feels certain that he has found the extreme limit of distribution, but thinks more of the same kind may possibly be found beyond. In mapping, the outmost known points were joined by lines that seemed, according to known habits of the tree, the most probable in consideration of the climate and topography.

It should be said that red fir, lodgepole pine, alpine balsam, and Engelmann spruce have a general distribution over the reserve, with the exception that red fir and lodgepole pine are not found above 7,000 feet. For this reason the distribution of these trees has not been specially indicated on the map.



A. CONTINENTAL DIVIDE, FROM HEAD OF LITTLE BADGER CREEK.



B. DÉBRIS FROM BURNT MOUNTAIN VALLEY TRIBUTARY TO DEARBORN RIVER.

From southwest slope of Mount Dearborn, 5 miles west of reserve line.

MISSOURI RIVER DRAINAGE OR EASTERN SLOPE OF CONTINENTAL DIVIDE.

Topography.—This tract, lying between the Great Plains on the east and the Continental Divide on the west, and between the Great Northern Railway on the north and Lewis and Clarke Pass on the south, is 12 to 30 miles wide and about 65 miles long, with an area of about 1,600 square miles. A small portion of this strip is level, undulating or rolling prairie, with general eastward slope. The foothills are mountainous, often precipitous toward the east, the tilted rock beds dipping southwestward, with their upturned edges exposed in cliffs fronting the plains, especially along the parallel ridges north of Haystack Butte. The numerous canyons formed by the streams cutting across the tilted strata are usually sharp and deep. The altitudes range between 5,000 and 9,000 feet (see Pl. XX, *A*).

Rock.—The peaks, ridges, and canyon walls of this region are composed of gray limestone. Very little other rock was found except on Birch Creek and the Teton creeks, where schists underlie the limestone unconformably, and on Smith Creek, where injected metamorphic rocks appear. The rock of the plains and some of the lower foothills resembles the Cretaceous beds common farther east. Among the limestones are some beds of slates and quartzites, but probably over 90 per cent of the rock on this strip is limestone. It is gray to buff in color and contains many fossil corals and brachiopods.

Soil.—The soil seems fertile and productive when moist enough. Probably 20 per cent of the area is without soil, the surface being bare rock, especially on the summits and steeper slopes. About the eastern foothills some alkaline spots are found, but such areas are small. In mechanical composition there is endless variety. Some clays are found along the eastern foothills and, rarely, in parts of the valleys among the mountains. Gravels prevail along the lower portions of streams or wherever alluvial deposits have been formed. Loam is found among the rocks on the slopes and, usually, near the hills along the creek bottoms.

Subsoil.—Clay subsoils are rare, although they are found east of the mountains, where there are many lakelets and ponds in the foothills. Clay is also found in the valleys of the mountain streams above dams caused by slides and mountain torrents or by the action of the now extinct glaciers. The greater portion of this tract has its scant soil resting directly upon the rock, but gravels and bowlder clays are to be found on perhaps 30 per cent of the area, especially in the valleys of Sun River and Dearborn Creek.

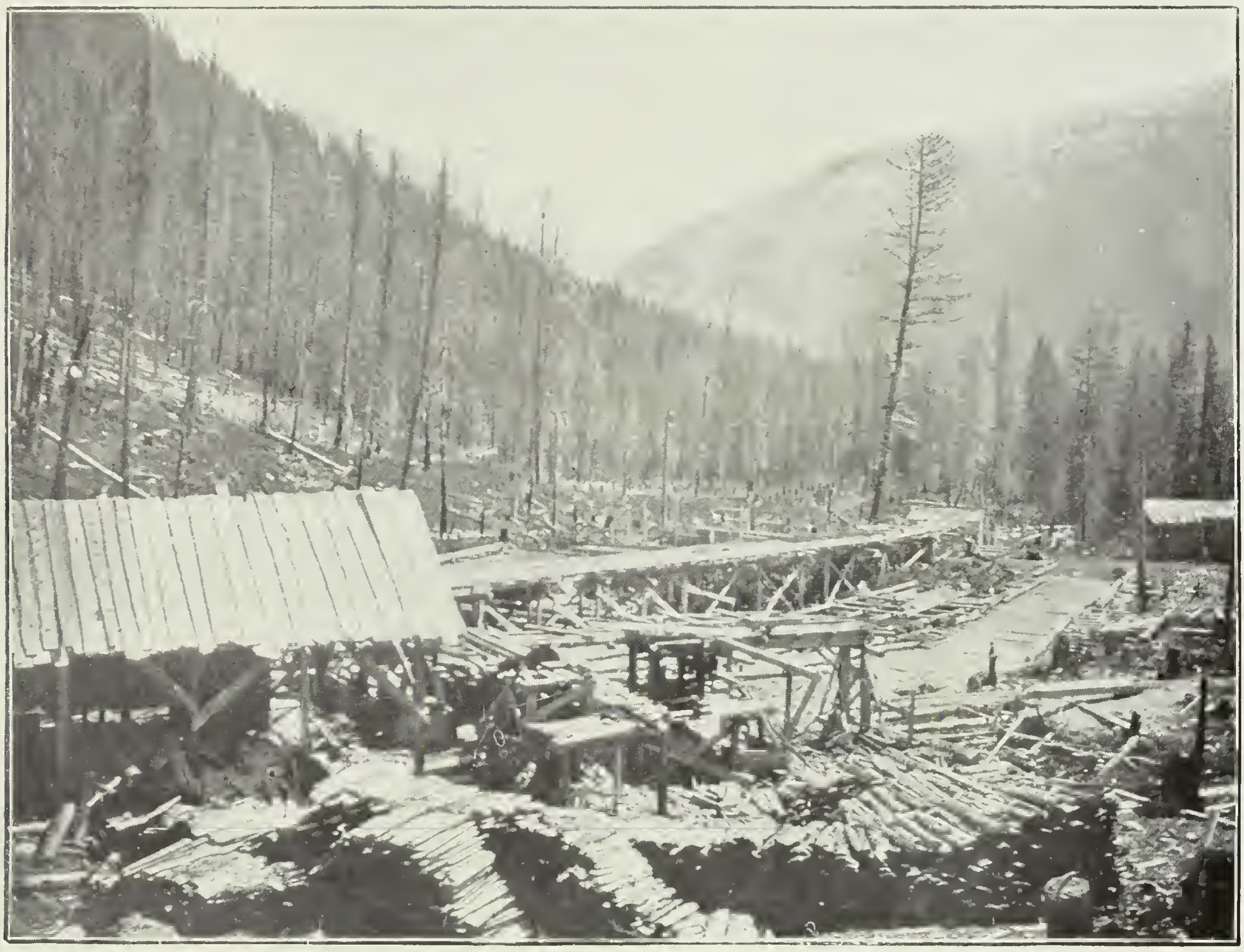
As a rule, humus is very light, owing to the dry climate, the frequency of fires, and the steepness of the slopes. On about half of the surface there is practically no humus, and on the remainder the soil is seldom colored to a depth of more than 3 or 4 inches. Where the foothills are so well watered as to prevent fires burning the humus, as about the mouths of the ravines and around springy places, there is often a foot of black soil. Without careful observation one may be led to believe the humus much more abundant than it really is, by seeing several feet of dark earth in the banks of some streams. Such deposits are small and are only in places where wash from the mountains or hillsides has accumulated. In forest which has been unburned for fifty years or more, as in the damp basins, sometimes 6 inches of black earth are found, but such areas are neither numerous nor large.

Litter.—Deadwood débris is not abundant. Although a large proportion of the trees are dead, the fires that killed them have as a rule been so recent that the deadwood has not fallen, while most of the débris from the older fires has been consumed by the later fires. In the remaining area of unburned forest, fallen leaves have accumulated to a depth of several inches.

Trees and timber.—The areas of forest that have escaped the general burn of 1889 and the other and lesser fires, both prior and later, are few and excepting along Badger Creek, Birch Creek, the South Fork of Depuyer Creek, the North Fork of Teton Creek, the South Fork of Deep Creek, and portions of the valleys of Smith Creek and Dearborn Creek the areas are so small and so remote and inaccessible as to make the timber on them of no commercial value. The amount of timber, regardless of accessibility, is roughly estimated on the basis of present usage in the northern middle States as follows:

Estimate of timber in Missouri River drainage in Lewis and Clarke Forest Reserve, Montana.

Areas.	Log timber.	Green small wood.
	M feet B. M.	*Cords.*
Badger Creek	10,000	300,000
Birch Creek	1,200	26,000
North Fork of Depuyer Creek		3,000
South Fork of Depuyer Creek	2,000	24,000
North Fork of Teton Creek	2,000	70,000
South Fork of Teton Creek	500	5,000
South Fork of Deep Creek	3,000	20,000
North Fork of Sun River	20,000	550,000
Middle Fork of Sun River	20,000	430,000
North Fork of Ford Creek	300	6,000
Smith Creek	2,000	25,000
Dearborn Creek	2,000	120,000
Additional small areas		660,000
Total	63,000	2,239,000



A. MILL ON SOUTH FORK OF TETON CREEK.

B. LOOKING UP VALLEY OF NORTH FORK OF SUN RIVER.

The additional small areas mentioned are scattered along the eastern front of the mountains. They are small tracts that have escaped fire. The wood on them is short and knotty—fit only for fuel. There are also on these slopes and on the foothills, fairly accessible from the plains, some 200,000 cords of deadwood of inferior quality, most of it killed by the fire of 1889.

The species composing this material are in order of predominance: Lodgepole pine, Engelmann spruce, Douglas spruce, and limber pine.

Engelmann spruce is the favorite log timber among the sawmill men. The wood of this species is white and tough. Though knotty, there are few black knots. In size some of the largest trees are 30 inches in diameter, and sometimes contain 500 feet of lumber.

Douglas spruce or red fir is usually small and very defective. Trees appearing sound on the outside often open with soft red, rotten spots in the heart or near the branches. The largest are about 30 inches in diameter.

Lodgepole pine is most generally distributed, and is mostly sound. While it is ignored and even considered a nuisance by some, its value will before long be appreciated. Farther west, where there is a moister climate and where larger and more sought timber can thrive, there may be some valid objections to its habit of densely occupying the ground immediately after a fire. Here it only occupies land on which other species do not thrive and produces lumber where no other species would. It reaches a diameter of 24 inches and a height of 70 to 80 feet, and is more frequently clear than any other timber. Logs as small as 5 inches at the top are sawed, and the lumber is sold (rough) for $15 per thousand, the same price as spruce and red fir, but it is sold under the name of "white pine."

Limber pine (*Pinus flexilis*) is usually so crooked and knotty as to be worthless for log timber and for the same reason is of little value for fuel.

Nut pine (*Pinus albicaulis*), while common in the higher altitudes of this region, is of no commercial value at present because of its inaccessibility. It is frequently found growing tall and straight, 8 to 10 inches in diameter and 60 feet high. It is easily distinguished from other white pines by its purple cones.

Cottonwood is found all along the lower streams, but seldom as log timber.

Aspen is usually associated with lodgepole pine and often succeeds limber pine on the burns.

Balsam is common only at high altitudes and is commercially unimportant for timber.

All species vary greatly according to exposure and moisture. Those that venture on the higher summits, which are both dry and exposed, form only mats upon the ground, while the same species in well-watered localities sheltered from the wind make large trees.

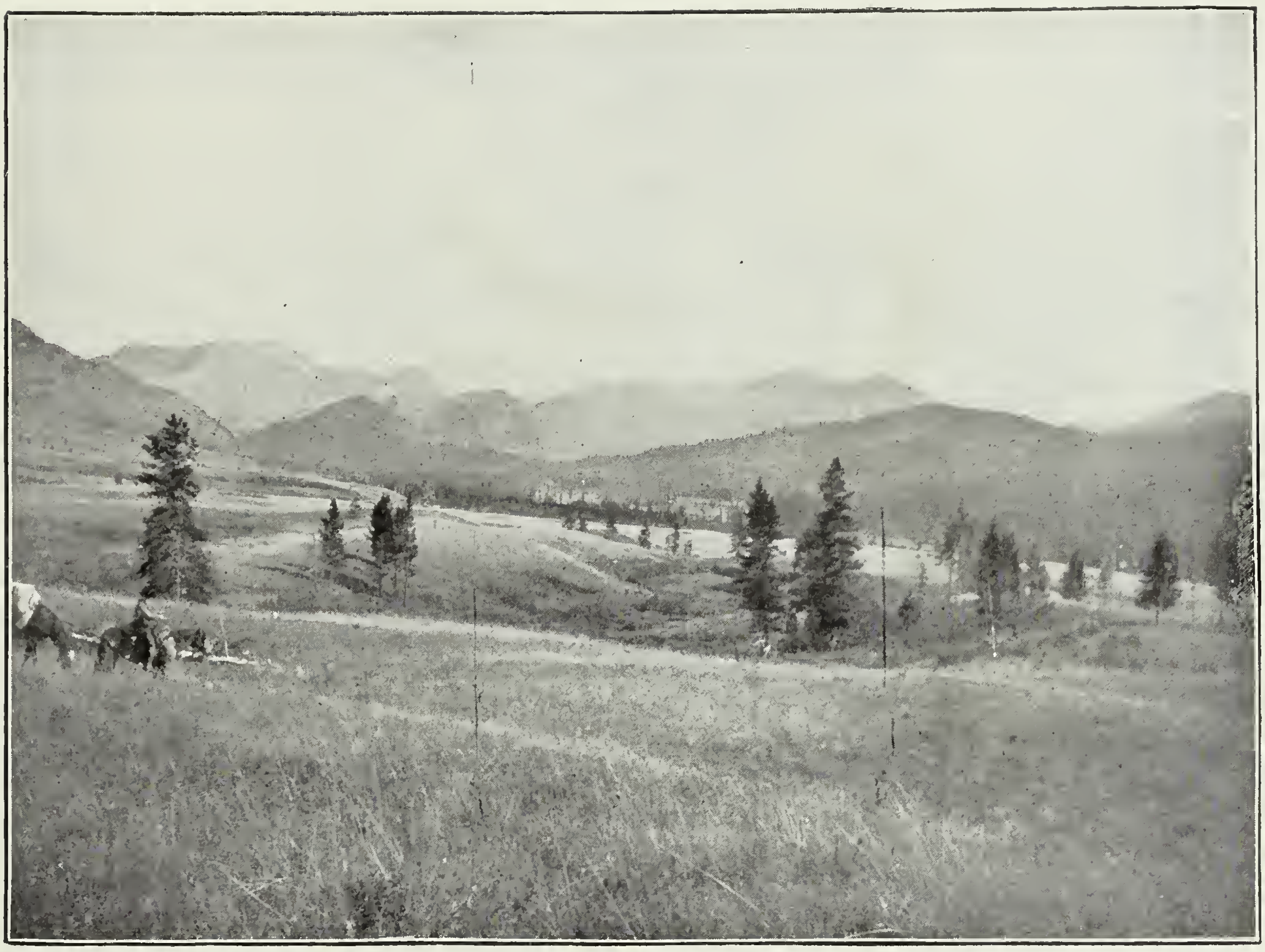
On the slopes a graduated difference is noticeable, according to the soil, moisture, and exposure. On the south side of Depuyer Creek where timber was being cut at an altitude of about 7,000 feet, Engelmann spruce, lodgepole pine, and Douglas spruce, on moist soil, average 150 to 500 feet per tree, but on the drier ground very few trees were large enough for log timber, and many of these were defective. In looking over the mountain side in this basin many small, brown areas of deadwood appeared in the green forest. These were first supposed to be the effect of fire, but examination proved them unburned, but on dry ground where no moist earth could be found near the surface.

Young growth.—Throughout the portion of this region facing the plains, an area of 600 square miles, tracts of young growth in good condition are rare. Where fires have run they have been so severe that over large areas no seed trees and no seeds have been left. In fact, on most of these burns the humus has been consumed. The few burns that have been restocked are about the basins at medium elevations where fires have been less severe, owing to greater moisture. Such restocking is best near the unburned tracts. In moving southward from the Great Northern Railway, a scant restocking was found on the Two Medicine drainage covering probably 4,000 acres south of the railway. South of that area the following small tracts of a few acres were seen: On Little Badger Creek (south of the stream), about 1,500 acres; about the head of Big Badger, some 5,000 acres; on the South Fork of Depuyer Creek, 500 acres; on Storehouse Creek, some 2,000 acres; on Beaver Creek, probably 3,200 acres; on Ford Creek, some 500 acres; on Elk Creek, 1,200 acres; on Dearborn Creek, 3,000 acres; on Falls Creek, 2,000 acres; a total, roughly approximated, of 37,000 acres.

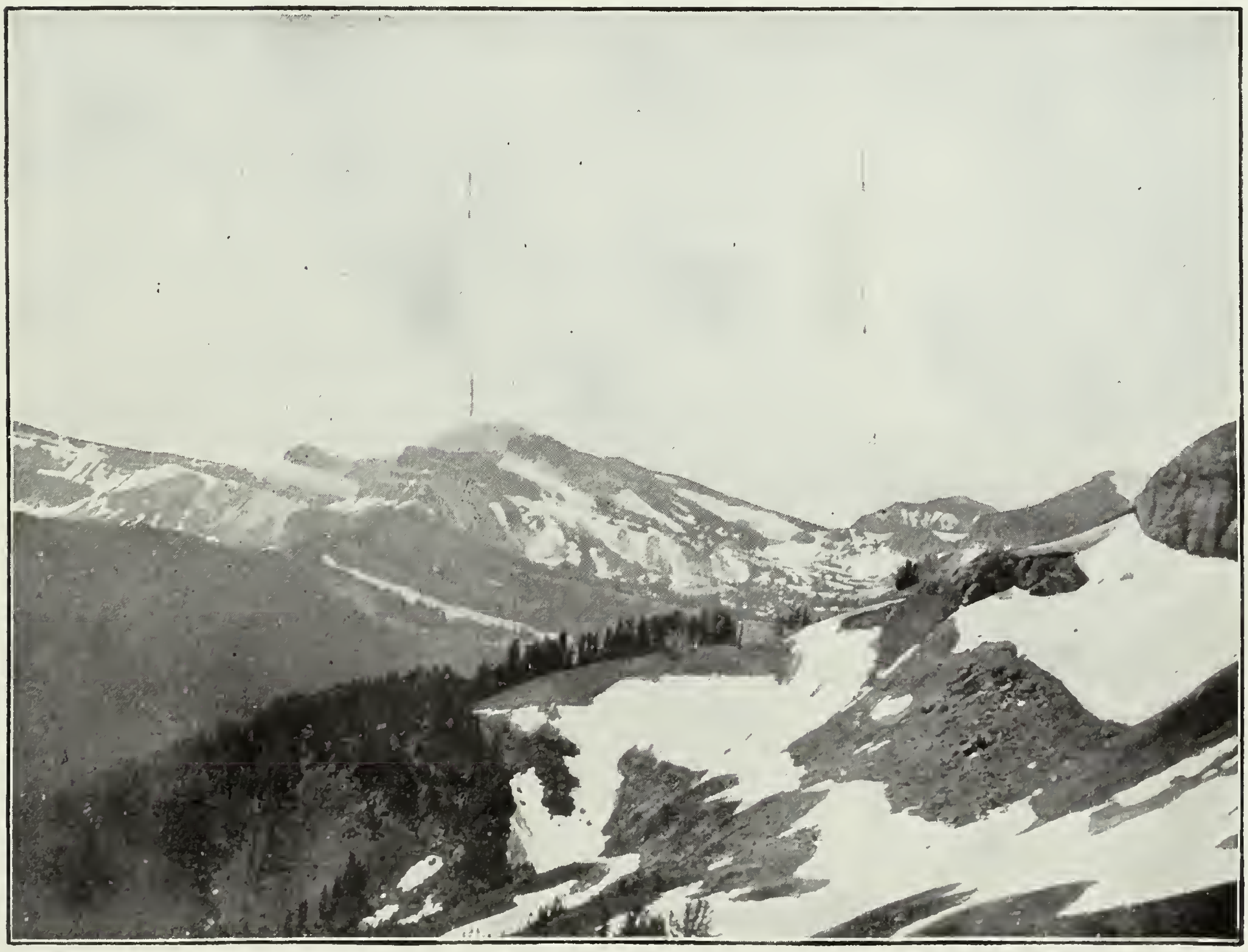
Underbrush.—Underbrush is scant throughout this region. Only on the dampest ground is there enough to cause serious resistance to travel. The prevailing species on the northern slopes are brittlebrush and huckleberry, while along the streams are clumps and narrow strips of dogwood and willow. In the higher altitudes much of the brush consists of species that under favorable conditions form trees. Such are balsam, limber pine, and Engelmann spruce. In the higher ravines near the Continental Divide, especially under Engelmann spruce, brush is often found so thick as to be a serious hindrance to travel, but unless accompanied by fallen timber it does not form an impassable barrier.

Fires.—Outside of the reserve about 45 square miles along the Great Northern Railway and 95 square miles in the foothills bordering the plains have been very seriously burned.

Of the 1,600 square miles within the reserve nearly 600 have been seriously burned within the past 40 years. Besides this severely burned area there are many lightly burned areas that now have some



A. VALLEY OF NORTH FORK OF SUN RIVER, LOOKING SOUTHWARD TOWARD JUNCTION OF NORTH AND MIDDLE FORKS.



B. HEAD OF MIDDLE FORK OF FLATHEAD RIVER.

dead trees killed by fire, but are principally wooded. There are also many areas of old burns that have been restocked. The areas shown as burned have been severely burned. The fire of 1889, which seems to have run over most of this area, occurred during a very dry time, and most of the ground over which it ran has only dead trees and a very small amount of humus left. Within this area this fire covered about 530 square miles, most of which is now bristling with dead trees, except in places previously burned. On such places nearly all the material has been consumed. A previous fire covered an undetermined area, the signs of it being on much of the ground, obliterated by later fires. On some 50 square miles, principally along the Continental Divide, plain evidence of the fires of this period remain. The dead trees and stubs left by these fires are better preserved in the high altitudes than in the valleys, as, being more isolated, they have partially escaped the later fires, which, on the foothills bordering the plains, have obliterated nearly all traces of the forest they have destroyed. Only occasional stubs and roots remain in the grass or brush. The dates given on the maps are those of the later fires.

Reproduction.—The area restocked is about 6 per cent of the area burned over. Almost invariably the restocking has been with the same species that occupied the ground before. There is, however, a noticeable increase in the proportion of lodgepole pine, doubtless owing to the more abundant seeding of this species and the favorable condition for its growth after fires. Where spruce and balsam lands have been burned over the new stock is invariably sparse. That this is the usual habit of these species in restocking is inferred from the condition of all of the old forests composed of them. Such forests do not have trees of uniform age, but always have young trees coming in among the sparse old stock. Reasons for this condition are found both in the scant seeding of these species in the higher altitudes where they grow and in their preference for shade in which to germinate and grow while young. Old forests of lodgepole pine frequently have young spruce and balsam as an undergrowth. The extensive, almost continuous burns on the foothills once partially covered with limber pine (*Pinus flexilis*) have not been restocked and so far as covered with vegetation have only weeds and brush if recent, or bear grass and scant forage plants if old. The principal bushes are willow and aspen. Young trees of limber pine are found on the half barren knolls that reach out into the plains and on the recently and severely burned lands. The condition of the burned land is most desolate. Only about 6 per cent of it is restocked and the remainder bristling with deadwood, standing or fallen, sometimes has no plants growing upon it, especially if high in altitude or dry. Most of the area, during the years that have passed since the fires, has grown only a scanty stock of weeds, grasses, or brush. The best pasture grasses are seldom found on the burns. Pine grass and "bear grass" (never eaten by stock) are more prevalent on such lands than the bunch grasses, but some grazing land is now found on the once wooded portions of the foothills. Although some ten years have passed since the principal fire, only about half the burned area is now covered with vegetation, and that is of very much less economic value than the original stock.

Effect of burns on water flow.—In the valleys or basins most thoroughly burned over the widening of the streams and the increased washing down of bowlders is quite noticeable. The valleys of Dearborn River, Ford Creek, and the forks of Teton Creek are much washed, the wide gravel and bowlder beds of the water courses being a prominent feature of the landscape (see Pl. XX, *B*).

Deadwood.—Wherever severe fires have recently run through the forests deadwood is standing. Even some of that killed by fire forty years ago remains standing, but only on the higher and drier portions where the climate is more favorable to the preservation of deadwood. Very little of such old material is suitable even for fuel and under the estimates only that killed within the past ten years which is standing and is suitable for fuel, fencing, or house logs is considered. None of the old deadwood is marketable as log timber. The estimate of the amount more recently killed is necessarily very rough and only approximate as follows:

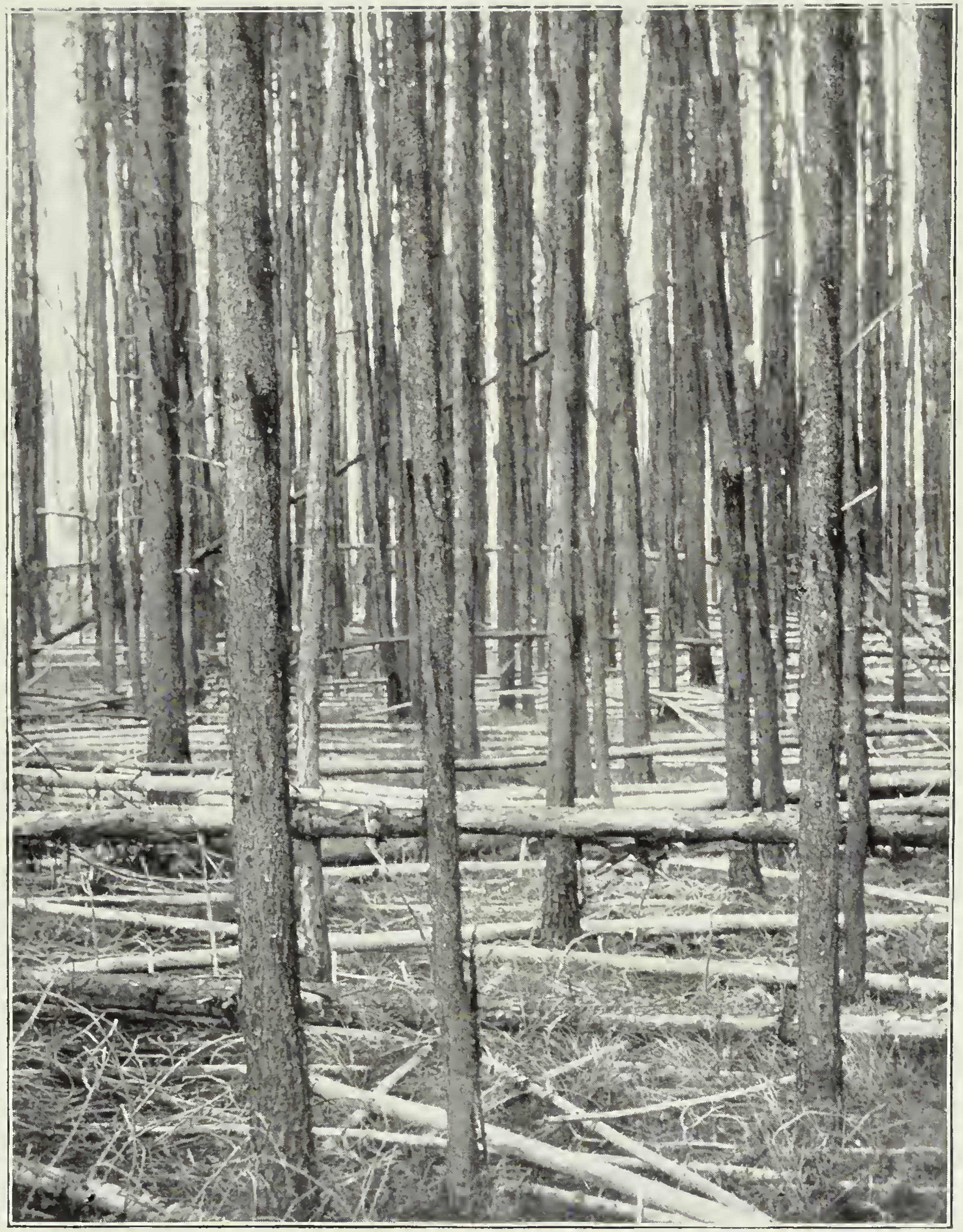
Estimate of deadwood in valleys east of Continental Divide, Lewis and Clarke Forest Reserve, Montana.

	Cords.
Two Medicine Creek	100,000
Little Badger Creek	500
Badger Creek	500
Birch Creek	30,000
North Fork of Depuyer Creek	10,000
Black Leaf Creek	5,000
Other valleys, southward	10,000
North Fork of Teton Creek	10,000
South Fork of Teton Creek	12,000
Other valleys, southward	6,000
Deep Creek	3,000
Other valleys, southward to Beaver Creek	8,000
Beaver Creek	5,000
Ford Creek	2,000
Smith Creek	1,000
Elk Creek	1,000
Dearborn Creek	80,000
Falls Creek	20,000
Sun River	200,000
Total	504,000

Some 20 per cent of this may have a stumpage value of about 25 cents a cord. The remainder is probably worthless, because of difficulty of access.

Cutting.—All that portion of this region fairly accessible from the plains has been invaded by ranchmen and by others cutting for village use. Wagon roads were found leading from the plains up almost every stream, and over these wood and poles, when needed, are hauled in small loads. Often the material can be taken out only with great difficulty. It is often cut high on the mountain slopes and slid down to the roads. In some places it is hauled a long distance from the stump to the wagon, where it is loaded, frequently 40 miles from where

A. HOMESTEAD CABIN.



B. NATURAL THINNING AMONG LODGEPOLE PINE, UPPER SWAN RIVER VALLEY.

it is to be used. Several small sawmills have been operated, and three were found running. On the South Fork of Depuyer Creek up to July 17 some 1,600 trees, scaling about 300,000 feet, had been cut in the basins and floated through the canyon to its mouth, where they were sawed and sold rough for $16 per thousand. On the South Fork of Teton Creek is a mill about 6 miles from the plains (see Pls. XIX, *B*, and XXI, *A*). In this valley about 1,000,000 feet of lumber and 6,000 cords of wood and poles have been cut. On Smith Creek a mill has been operated some years, and from this valley about 1,000,000 feet of lumber have been taken, most of it lodgepole pine and spruce (see Pl. XII, *A*). It is not far from the unsurveyed reserve line, but there is little doubt it lies within the boundaries. On Dearborn Creek something over 100,000 ties were cut and floated to the Helena branch of the Great Northern Railway when that line was being built. In the valley of Falls Creek, a branch of the Dearborn, large quantities of poles and fuel have been cut. August 2 a party of half-breed Indians was found cutting 10 to 20 loads a day and hauling them to market on the plains.

Owing to the desultory manner of such cutting, accurate estimates of the amount cut are impossible without much time and labor.

Approximately the following amounts of both green and dry material have been cut within the reserve:

Estimates of cutting east of Continental Divide, Lewis and Clarke Forest Reserve, Montana.

Locality.	Cords.	M feet B. M.	Ties.
North of Badger Creek	2,000		
Badger Creek	2,000		
Birch Creek	2,000		
Birch to Teton Creek	5,000		
South Fork of Depuyer Creek		300	
North Fork of Teton Creek	6,000	1,000	
South Fork of Teton Creek	5,000	600	
Teton to Sun River	22,000		
North Fork Sun River	25,000		200,000
Sun River to Smith Creek	10,000		
Smith Creek		1,000	
Dearborn River			150,000
Falls Creek	3,000		
Total	82,000	2,900	350,000

Transportation.—The point on this land nearest the railroad is about 5 miles distant and the farthest is about 80. The streams, with the exception of Sun River, are of little value for transportation, as they are rapid and rough and the diversity of their directions and the small amount of timber to be marketed from each would hardly warrant their improvement for log driving, although the water could often be used to advantage in bringing material from the mountain basins to the mouths of the canyons on the border of the plains, the most favorable situation for mills.

Demand.—Demand at present is purely local and only from the plains eastward, whence ranchmen and villagers look to the mountains for all their wood material. Sawed lumber brings $16 a thousand at the mill in the foothills and, according to accessibility, should bear a price of from $1 to $3 a thousand on the stump. Fuel and fence poles, though nothing has heretofore been paid for them, should be worth 25 cents a cord on the stump. The amount of material used on the adjacent plains will be greatly increased as irrigation is developed and the land capable of agriculture cultivated.

Agricultural land.—There are on this portion of the reserve approximately 150 square miles of land that have some agricultural value. Some of it is cultivated now and is very productive of crops not liable to injury by frosts. Timothy grows especially well. About 80 square miles of this land lies east of the foothills in that angle of the reserve reaching into the plains south of Birch Creek. This land should be opened to settlement. On the North Fork of Sun River, the tract next in size, are about 5 square miles of agricultural land (see Pls. XXI, *B*, and XXII, *A*). The remainder is in small isolated areas here and there, not adapted to farming, but of value for raising hay and vegetables for the use of men employed in the forests.

Irrigation.—The amount of water used in the reserve at present is insignificant. Perhaps altogether 100 acres are now under irrigation. These lands are some garden spots and hay land in the angle south of Birch Creek; Hannon's ranch, on Storehouse Creek (a branch of Sun River); and two ranches on Ford Creek. East of the reserve several large ditches are being used. The only one of these reaching the reserve is that tapping Dearborn River at the mouth of Falls Creek. The possibilities of irrigation on the plains eastward are great, as there is a large amount of rich, irrigable land. In view of the future demand for water, the destruction of the cover on the mountains is greatly to be regretted. Although the principal burns occurred only ten years ago, their effect upon the waterflow is plainly noticeable in the widening of the streams, the cutting of the banks, and the great deposits of gravel.

Occupancy.—While no great amount of the land is utilized, small tracts are used here and there. Most of these are on the plains, in the angle south of Birch Creek. These were not examined in detail. On Sun River are two ranches, Hannon's and Wagner's (see Pl. VI, *B*). Hannon has about 100 acres under cultivation and in pasture, while

A. ENGELMANN SPRUCE ON MOUNTAIN SIDE, SOUTH OF UPPER MONTOUR CREEK.

B. STUMP LAND UNBURNT, ADJOINING RESERVE ON SOUTH.

Wagner has 200 acres fenced in in pasture, and Hannon has about 30 horses on the North Fork of Sun River. On Ford Creek two ranches were found; one, recently established, has no land under cultivation; the other, on the main stream, has about 100 acres in grain and hay. At the head of Ford Creek about 500 cattle and as many sheep were found grazing July 27. This stock is owned by several different persons, the Fords, having ranches on the lower creek, being the principal owners. About the mouth of Falls Creek are several cabins occupied by half breeds who cut and saw wood from the reserve. About 5,000 sheep, said to be owned by J. C. Fay, of Hogan, Montana, were grazing in the valley of Falls Creek August 1.

Water power.—The numerous streams (averaging about 6 miles apart) furnish many water powers along the eastern border of the reserve. Sun River, the largest, was about 300 feet wide and 3 feet deep, with rapid current July 24. Dearborn River, next in size, was 100 feet wide, 2 feet deep, and moderately rapid. Ford, Deep, Depuyer, Birch, and Badger creeks in July were each 25 feet or more wide and 2 feet deep, with strong current.

Mining.—Some prospecting for gold and copper is being done on Smith Creek. Otherwise no mining operations were noticed. The principal rock is limestone.

VALLEY OF MIDDLE FORK OF FLATHEAD RIVER.

Topography.—This valley lies partly within and partly without the reserve. About 576 square miles, in a fairly compact body, are included within the boundaries. The portion of the valley outside the reserve is a strip, seldom more than 4 miles wide, along the Great Northern Railway. The portion within the reserve, while not reaching into the highest altitudes of the range, is still very rough and mountainous, excepting along the bottoms of the main valley and the two principal branches. With this exception there is very little level land. The principal areas are occupied by irregular mountain ridges and peaks, the highest of which hold snow in drifts throughout the year. The portion outside the reserve is simply a mountain side along Summit Creek and the Middle Fork of Flathead River below the mouth of Summit Creek.

Rock.—Limestone is the principal rock occupying the summits of all the higher ridges, but shales and schists are found in the banks of the river where it cuts across the range. Some beds of quartzite outcrop in the mountain sides, but these are much thinner than those in the mountains north of the railroad.

Soil.—As the soil is derived principally from limestone, it may be expected to be rich in plant food; and, in fact, wherever there is moist earth, unencumbered by snow, vegetation is luxuriant. A large part of the mountain summits is bare rock. Much of this area was once wooded, but fires have so thoroughly consumed the mosses and humus covering the surface that trees could not grow there now.

Litter.—The amount of litter in this valley is greater than in any of the others. On the burned areas the trees killed by fire form a network over the ground, except where fires have been repeated and severe. On the unburned areas, covering nearly all of the two main forks of the valley, the old trees and others killed by overcrowding have fallen and such an amount of material has accumulated that it is difficult to take horses through the woods.

Humus.—Corresponding with litter, humus is very light or wanting on the burns and heavy where the forest is uninjured by the fire. Both the west branch and the east are covered by a dense growth of trees, and excepting a small area near the forks have escaped fire many years. This freedom from fire has permitted humus to accumulate to a depth of 2 or 3 inches over most of the valley. There are occasionally willow bottoms where black muck has a depth of a foot or more, but these have no large area.

Trees and timber.—Of this tract about 124 square miles are timbered. Besides this, 110 square miles are fairly covered with wood, about 180 are naturally bare, being on the high summits, and 162 square miles have been severely burned. Outside of the reserve some 35 square miles are scantily wooded with spruce and balsam, with some lodgepole pine, larch, and red fir on the lower slopes—perhaps 20 million feet B. M. of log timber and 200,000 cords of other material. The remaining 115 square miles are either burned or naturally barren. The species here do not differ from those in the South Fork Valley. Engelmann spruce is the principal timber tree. Larch, red fir, and lodgepole pine follow in importance. Balsam abounds on the higher mountain slopes, but is of little or no commercial importance. White pine may occur, but it was not noticed.

Estimates.—The amount of log timber in the portion of the valley within the reserve is roughly estimated at 154 million feet B. M. Besides this log timber, there are about 1,500,000 cords of material unfit for the saw. The log timber is about 30 per cent spruce, 25 per cent larch, 20 per cent lodgepole pine, 20 per cent red fir, and 5 per cent other species. As to size and quality, there is great variety. In the ravines are tall and straight spruce of rapid growth and usually sound, while on exposed ridges are dwarfed and knotty trees often defective.

Young growth.—Except on the burn on the main fork of the stream, there is no great amount of young growth. On the larger burns restocking has been scant and the trees are yet small. Among the older trees some young ones have started as the mature trees have fallen and made openings. These are of various sizes and are promising for timber. But there are not in all cases enough to form a new stock of desirable kinds if the old trees were cut. The abundance of brush is a serious hindrance to the starting of seedlings.

A. SWAN LAKE, LOOKING SOUTHWARD FROM POINT 3 MILES ABOVE OUTLET.

B. LOOKING TOWARD McDONALD PEAK FROM SWAN-CLEARWATER PASS.

Underbrush.—Underbrush is more abundant than in any other portion of the reserve. The litter and brush make the trail through this valley almost impassable. Most of the hills east of the river, however, have been burned until they are almost free from brush. West of the river burns are older and brush has had time to reappear.

Fires.—About 95 square miles within the reserve and 60 outside of it have been severely burned within the past twelve years. The hills east of the river are almost barren as a result of fire. The origin of most of these fires seems to have been along the railway, and they probably started either during the grading operations, or from sparks, cinders, or camp fires along the line since. It is said that at the time of the grading of the road there were two dry seasons, and fires were burning everywhere through the mountains. These statements are confirmed by the conditions in which we now find the forest. The fires at this dry time were almost invariably severe, killing all the forest through which they ran. Very few trees, indeed, are left living; only a few clumps in damper places, often several miles apart. Owing to the severity of these burns, reproduction has been scant. Most of the new stock is lodgepole pine, and most of this is near the border of unburned forests. Probably not over 20 per cent of the burns are restocked with seedlings of any species. The view over the mountains south of Bear Creek reveals a very few small unburned tracts in the most sheltered places, but the surface is nearly all bare, with the exception of a few dead trees, either standing or fallen.

Deadwood.—Perhaps 100,000 cords of deadwood are standing within this portion of the reserve and 150,000 cords outside of the reserve line along the railroad.

Cutting.—Within the lines of the reserve there has been no cutting except for camps and trails, but on the adjoining strip a great deal was cut during the construction of the railway for ties, bridge timber, and fuel. No attempt was made to estimate the amount of this material, as there was not time.

Transportation.—The only outlet for this valley is down the stream. The stream is drivable at moderate expense, and at Java touches the Great Northern Railway. The material outside the reserve, in the narrow strip along the railway, is, compared with the rest of the region, very accessible, as it is only necessary to chute the timber down the mountain side to load it on the cars.

Demand.—Probably none of the material on this tract could be sold to-day at any price on the stump. East of this point, as at Midvale, and even near Summit, there is a growing demand for deadwood to be used on the plains eastward, but as this tract is on the western slope and below some of the heavier grades it could probably not compete at present with material from the eastern slope of the mountains, which now commands a price of only 25 cents a cord on the stump.

Agricultural land.—There is no prospect for agriculture in the valley except, perhaps, that on a few spots the vegetables or hay needed by lumbermen or miners working in the valley could be grown.

Water power.—Water power is abundant, the rapid fall of the stream furnishing many mill sites.

Occupancy.—There is no one living within the reserve, but along the railroad below are some three or four resident squatters. Essex is quite a little village, supported by railroad work, this place being used as a coaling station and for keeping engines used in helping up the mountain grade. At the other stations—Bear Creek, Java, Paola, and Nyack—are nothing but section houses.

Mining.—Along Summit Creek, not far above Java, are some mining prospects, staked during the season of 1898. Aside from these no claims were noticed in the reserve.

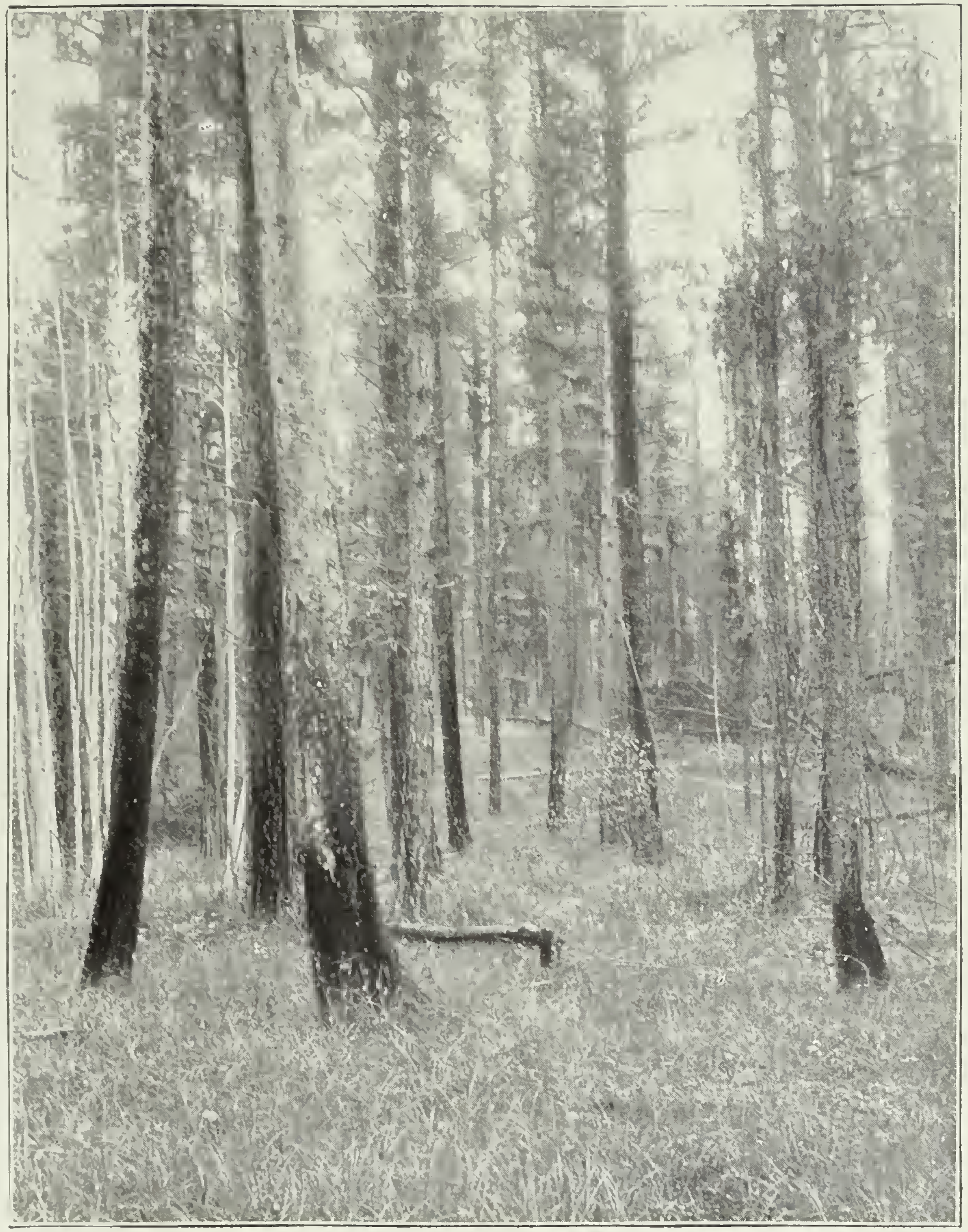
VALLEY OF SOUTH FORK OF FLATHEAD RIVER.

Topography.—The area of this tract is about 1,860 square miles. Excepting about 240 square miles draining into the Blackfoot, of which the surface is irregularly mountainous, with very narrow stream bottoms, this area comprises the whole drainage basin of the South Fork of the Flathead River. This basin is about 92 miles long and from 10 to 30 miles wide. It is bounded on the west by the high and sharp Kalispell Range, on the east by the Sheep Horn or Stanton Range, which southeastward joins the Continental Divide and with it forms an irregular boundary. This range has very rough topography on its western slope.

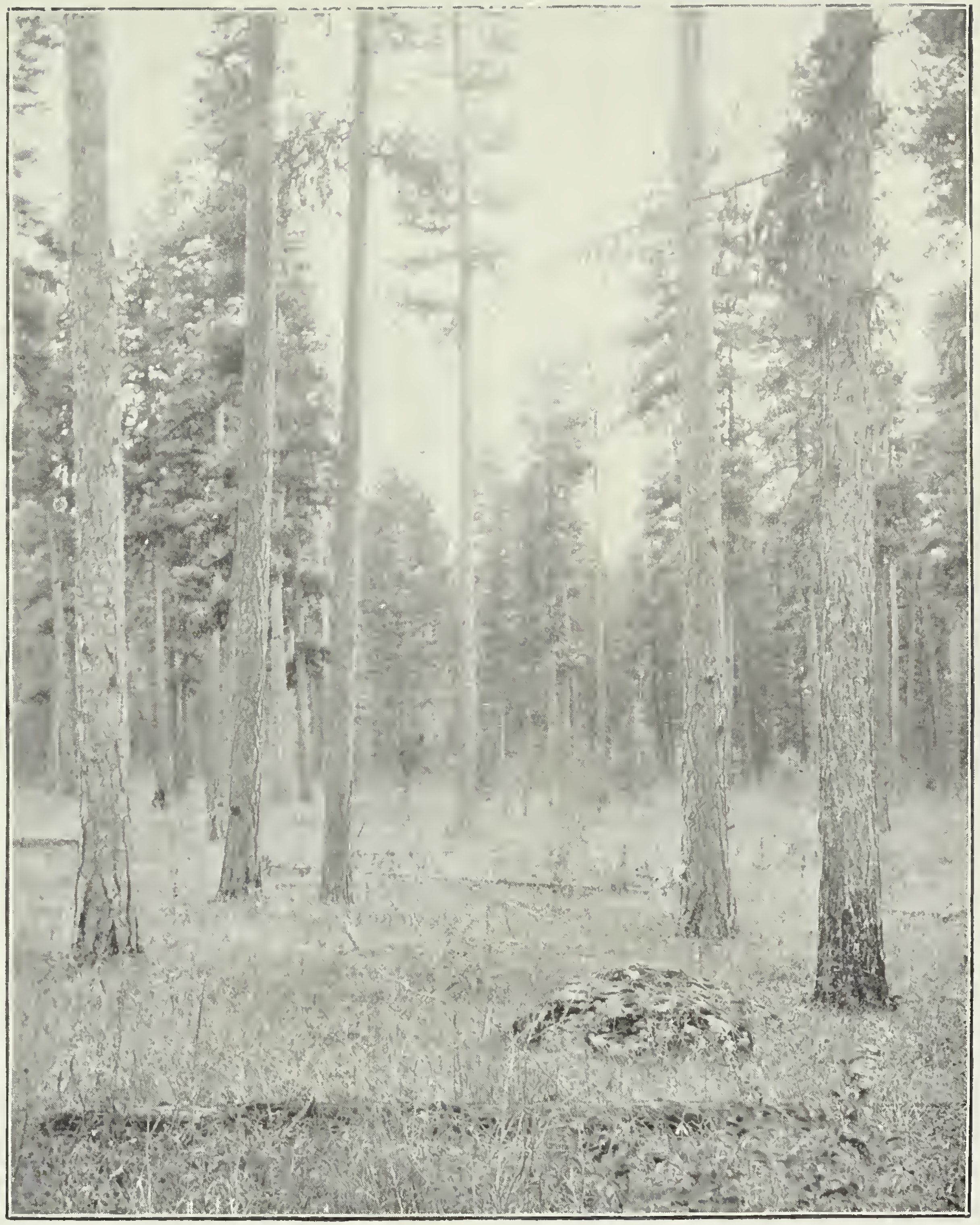
For some 40 miles above the mouth of the South Fork the valley is narrow and, excepting some recesses in the mountains eastward, fairly uniform, but above or southward the parallel ridges forming the foothills of the Continental Divide are sharply cut across by streams, and a very rugged topography is the result.

The west branch of the South Fork has a fan-shaped drainage, the western tributaries of which head in the mountains about Pend Oreille Pass and flow through sharp canyons until they reach the main stream.

Willow Creek, which joins the West Fork to form the South Fork of the Flathead, has a much broader valley bottom than the West Fork. Above the first canyon there is an area of gravelly land with a maximum width of about 3 miles. About 8 miles above the first canyon is a short canyon through a ridge which cuts the valley in two near its middle. Above this canyon is a willow bottom about 7 miles long and from half a mile to a mile wide. This glaciated U-shaped valley continues southward beyond the headwaters of Willow Creek to those of the North Fork of the Blackfoot. The divide between the two streams is so low that the headwaters of Willow Creek could easily be turned into those of the North Fork of the Blackfoot.



A. MIXED FOREST OF YELLOW PINE, LODGEPOLE PINE, AND LARCH.



B. YELLOW PINE AND LARCH, UPPER SWAN RIVER VALLEY.

Rock.—Limestone forms the principal crests on each side of the valley, and in the limestone are some beds of quartzite, the quartzite being most abundant southward, where a transverse uplift, which reaches across the whole Rocky Mountain Range, forms the divide at the head of the South Fork of the Flathead River. Along both the Sheep Horn and the Kalispell ranges green schistose rocks are found in occasional outcrops. The lower portion of the valley of the South Fork is occupied by Cretaceous or allied rocks, in which are some beds of lignite coal.

Soil.—Derived almost entirely from limestone rocks, the soil is productive wherever loam is abundant and well moistened, but large areas are gravelly and too thoroughly drained. Near the mouth of the tributaries, however, there are usually some areas of very fertile soil. The mountain ridges are usually bare and rocky. The slopes below produce a vigorous growth of such vegetation as can endure the peculiar variations of excessive moisture and drought to which these mountain sides are subjected. Throughout the valley are many isolated small areas of wet land, commonly called sloughs, which now have a growth of wire grass, flat grass, or blue joint. These have a deep accumulation of muck, which usually proves fertile after draining and weathering. The depth of the soil is usually very slight, seldom more than 2 or 3 inches on the bench lands, although it may reach 6 inches, or even a foot, about the mouths of ravines.

Subsoil.—The subsoil is greatly variable. In general, the banks and benches along the river are gravel; yet, in many places, clay banks are exposed in river bluffs and miry tracts of clay can hardly be avoided by the trails. For several miles below the mouth of Whitewater River much clay was noticed, both in the bluffs and on the river bottom. Some of these clay deposits are saline, especially near the tops of the bluffs, which are often 200 feet above the river. The beds are stratified and probably settled in post-Glacial time from water held back by a natural dam, a short distance below the mouth of Bear Creek. Such dams must have been common as the glaciers were receding, for along the main valley many terraces are seen and at several different levels. As a rule, the gravels do not extend far up the mountain side, and above them the subsoil is practically formed from the local rock and consists largely of clay mingled with rock fragments. The general color of the subsoil is a reddish buff or brown.

Humus.—Humus is fairly abundant, except on burns and gravel ridges, where it is slight in proportion to the intensity of the burn or the dryness and exposure of the ridge. This soil has been formed since the recession of the glaciers and is but slightly colored by humus. The color seldom exceeds a depth of 2 or 3 inches. In the unburned forest, well-decomposed material is commonly found 2 or 3 inches deep. But where burned, all such material is consumed, except in the damper spots, or where the fire has been exceptionally light.

Litter.—There is only a moderate amount of litter, even on the burns. Most of the fires that have occurred have been severe and have cleaned up the smaller litter quite thoroughly. That falling since the fire of 1889 is coarse and principally the trunks of trees killed by that fire. In the unburned woods the trees killed by overcrowding and the branches that are overshaded and drop off accumulate to a moderate amount, but are seldom so abundant as to obstruct the passage of horses through the woods.

Trees and timber.—Larch, red fir, spruce, yellow pine, white pine, and lodgepole pine are the principal timber trees. In addition to these, balsam, nut pine, cedar, hemlock, and cottonwood occur, the first two abundantly on upper mountain slopes and sometimes reaching to the valley bottom. Silver fir and cottonwood occur sparingly (see Pl. XXIV, *A*).

Roughly estimated, according to the custom in the Lake States, the amount of log timber and other material above 3 inches in diameter is as follows:

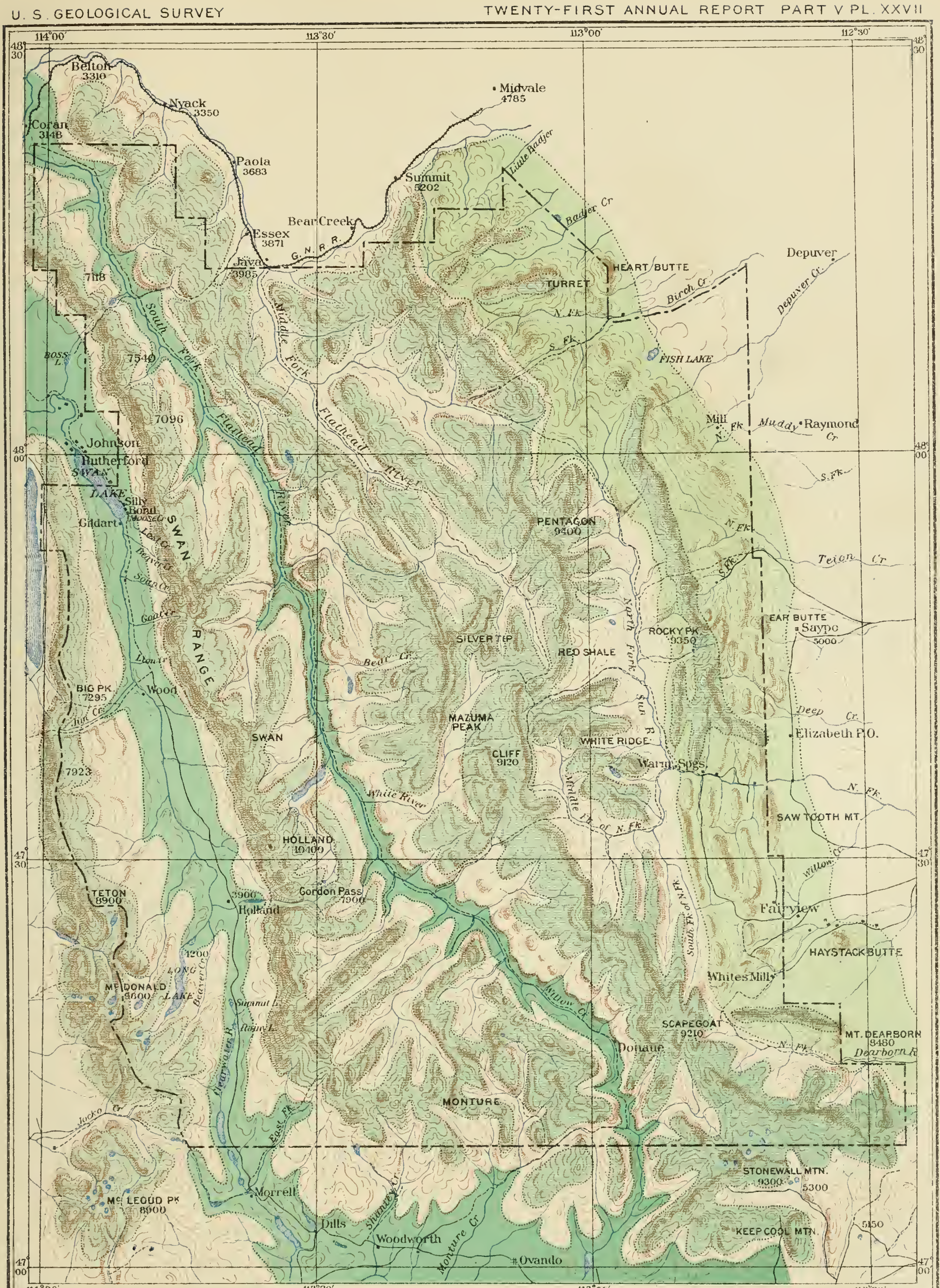
Amount of log timber above 3 inches in diameter in valley of South Fork of Flathead River, Montana.

Species.	Feet B. M.	Cords.
Larch	176, 944, 000	1, 000, 000
Yellow pine	35, 388, 800	
Red fir	110, 590, 000	876, 000
Spruce	88, 472, 000	1, 096, 000
White pine	8, 847, 200	300, 000
Lodgepole pine	22, 118, 000	1, 008, 000
Balsam		800, 000
Cedar, hemlock, and others		50, 000
Total	442, 360, 000	5, 130, 000

The maximum sizes of the timber are approximately as follows:

Size of timber in valley of South Fork of Flathead River, Montana.

Yellow pine	40 inches by 90 feet
Red fir	36 inches by 80 feet
Larch	40 inches by 150 feet
Spruce	30 inches by 100 feet
White pine	30 inches by 125 feet
Balsam	20 inches by 70 feet
Nut pine	20 inches by 70 feet
Lodgepole pine	24 inches by 90 feet



JULIUS BIEN & CO. N.Y.

LEWIS AND CLARK FOREST RESERVE
MONTANA

Showing distribution of yellow pine, white-bark pine, and limber pine
Prepared under the direction of Henry Gannett, Geographer in charge
BY H. B. AYRES

Scale
5 0 5 10 15 20 25 30 Miles

Sketch contours
1899

LEGEND

🟩	YELLOW PINE (Pinus ponderosa)	🟩	WHITE-BARK PINE (Pinus albicaulis)	🟩	LIMBER PINE (Pinus flexilis)

In quality there is a great variety, according to the situation where grown. In general, the timber has grown in dense forests and is fairly free from large knots.

The yellow pine, as usual, borders the prairies and other openings, and is limby above the first 25 or 30 feet from the ground. It is often fire scarred in the butt.

Red fir, while less defective here than on the eastern slope, is often found full of dry rot.

Lodgepole pine is usually sound and fairly clear, though small.

White pine is frequently defective; in fact, it is seldom sound. Much of it is dying, and in dying the sapwood turns blue. Besides this defect, it is common to find dry rot in the trunks, and the many defective logs greatly increase the cost of logging.

Some cedar 34 inches in diameter and 75 feet high was seen, but this size is exceptional. There are no large areas of this species. It is limited to ravines and other damp places.

Nut pine is greatly variable in quality, seldom being suitable for log timber, and where suitable it is so inaccessible as to be of no commercial value.

Young growth.—With few exceptions, there is a fair stock of young trees throughout the forest. The tracts not burned have young trees coming in where the old have fallen. Most of the burns in the low country are being fairly restocked, but the burns of 1889 were so severe that reproduction on them, as found on Hungry Horse, Upper Gordon Creek, and the eastern slope of the Kalispell Range, has been scant. Willow Creek, however, is fairly well stocked, but all the young growth there is small, usually from 2 to 10 feet high. But little of the unburned forest lacks sufficient young growth to constitute a new stock were the mature trees cut. On the burned land, however, the trees being small and usually all of one kind, the problem of thinning and securing a valuable stock would be a more difficult one, for the severe burns have little else than lodgepole pine.

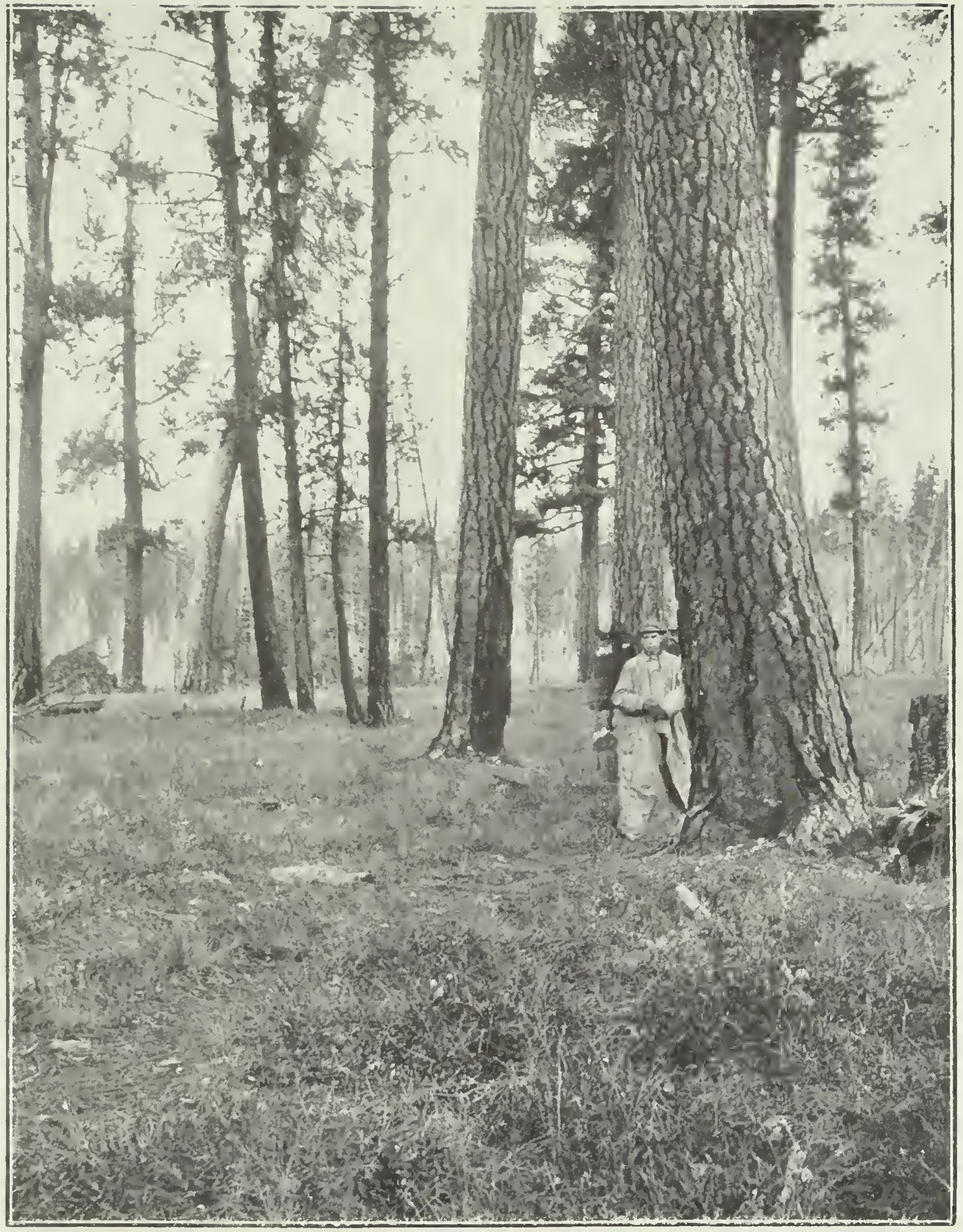
Underbrush.—The species most abundant here are alder, maple, spiræa, dogwood, willow, brittlebrush, yew, juniper, redroot, and squawberry. These are often dense enough to form a serious obstruction to logging operations, especially on or near the bottom, where dogwood and yew are dense under the spruce. These species follow up the water courses into the gulches on the mountain sides, leaving ridges, especially the moraines, fairly free from brush. The northern mountain slopes, especially in high altitudes, have brittle brush and huckleberry in some abundance. The medium altitudes, both on the slopes and flats, especially if moist, have maple and yew often so dense as to be difficult to pass through; but the southern slopes and gravelly benches have some clumps of alder, service berry, squawberry, and redroot, but, as a rule, not enough brush to obstruct travel through them.

Fires and reproduction.—On the Blackfoot drainage about 175 square miles, and on the South Fork of Flathead inside of the reserve about 310 square miles, and outside of the reserve 10 square miles, have been burned over severely. Most of this area was burned, some of it for the second time, in 1889. All the burns indicated on the map (Pl. III) have been severe, and very few live trees are left on these areas. They frequently have a network of fallen trees, among which some dead trees remain standing. Most of the humus has been burned off, and the earth is left bare. Along the borders of surviving forests conditions seem to be favorable for reproduction. In such places the forest has furnished seed, which has found a good place to germinate in the bare surface left by the fire. Away from the green woods, however, and in the high altitudes, where seeding is less abundant and where the less productive balsam and spruce prevail, the young stock is far less abundant. In the valley of Willow Creek reproduction is especially good, and 40,000 young lodgepole pine to the acre are frequently found. Some of the damper areas have a stock of Engelmann spruce and red fir or larch. The areas subjected to repeated fires have very little new growth, and this is almost invariably lodgepole pine.

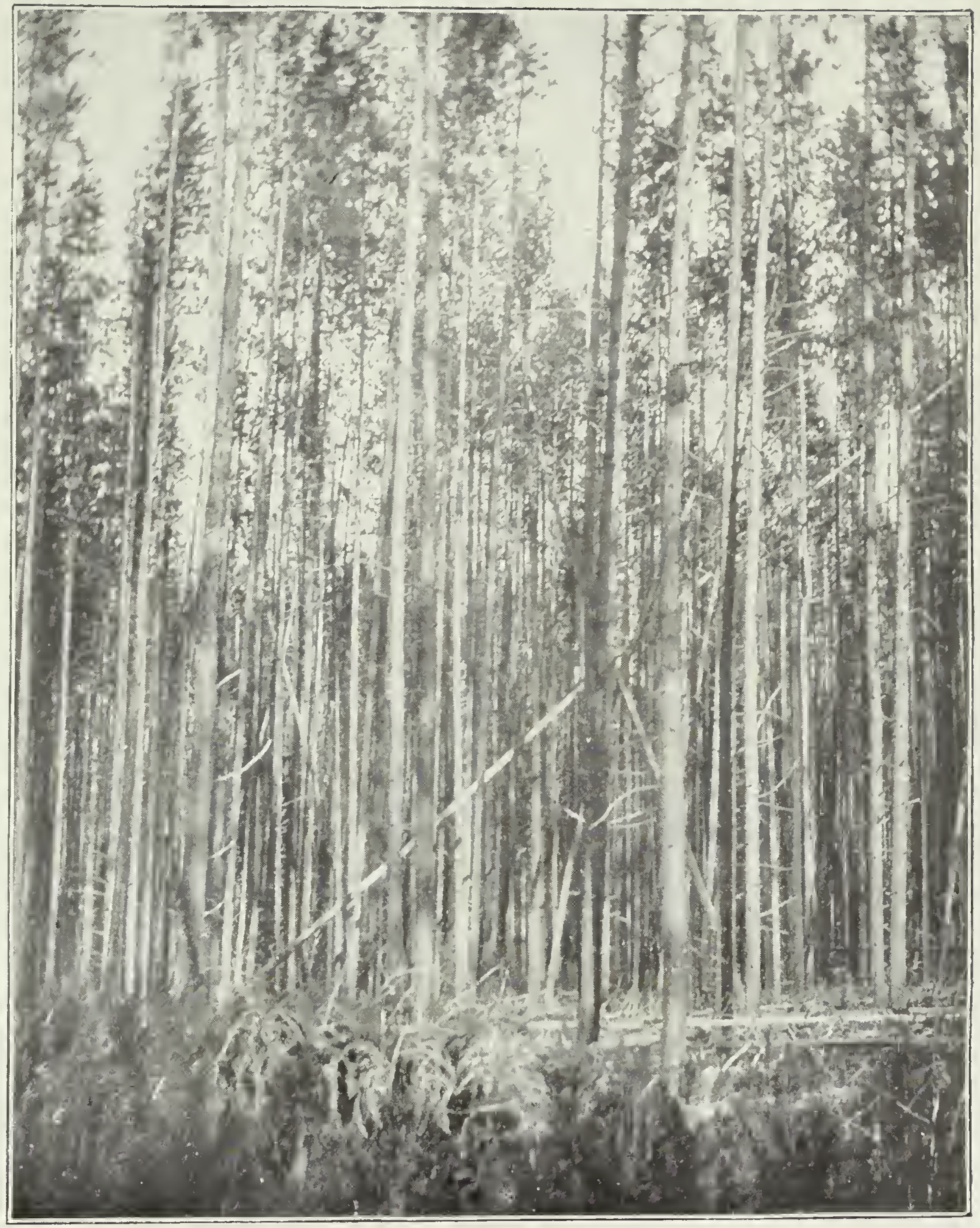
There is no doubt that some of the fires, especially on the higher ranges, are due to lightning, but most of those in the valley seem to have been set by Indian and other hunting parties or by prospectors. The trails most frequented by Indians, as the Jocko and Pend Oreille, are noticeably burned, especially about the camping places. The lower portion of the valley shows the effect of railroad fires, started either during the construction of the road, or by campers along the track, or by sparks from locomotives.

Effect of fires.—These fires have greatly reduced the area of wood lands; in fact, the forest here is some 450 square miles less on account of them. The humus and fine litter consumed has probably averaged 2 inches in depth, aggregating, approximately, 86 million cubic yards.

The effect of the fires upon the composition of the forest has been to increase the proportion of lodgepole pine. Probably 90 per cent of the stock coming in is of this species. The effect of fires upon the policy of forest management must be serious. The new stock of trees will not be large enough for any commercial use for nearly fifty years, and in composition these burned tracts are reduced to less desirable species. On old burns some inclination to return to the original species was found, notably on the head of the North Fork of Blackfoot River, where spruce was found coming in under lodgepole pine. Larch, red fir, and white pine, too, sometimes reappear under lodgepole pine on old burns, but this reappearance is always slow, and marketable log timber can hardly be expected from these species naturally reseeded on burns in less than one hundred years.



A. LARGE YELLOW PINE, 2 MILES NORTH OF HOLLAND'S RANCH, UPPER SWAN RIVER VALLEY.



B. LINE OF BURN OF 1889 IN LODGEPOLE PINE.

Deadwood.—The amount of deadwood standing is only about 600,000 cords, and this has no market value where it stands. Probably all will be fallen before it becomes accessible or marketable.

Cutting.—There has been no cutting on this tract except for cabins and camp use, unless it be in the extreme northwest corner of the reserve, which could not be located exactly, as the boundary lines there have not been surveyed. Many ties were made in that vicinity and put into the track during the construction of the road.

Transportation.—The only way to get timber out of this region is northwestward, or down the stream. Were it not for several bad canyons, the river would be drivable for at least 80 miles above its mouth. It is possible these canyons can be improved so as to permit log driving, but the expense would be great. Elsewhere on the river driving would often be difficult because of the wide bed of the river and the frequent gravel bars. A railroad along the river could be built with easy grade, but the expense would be considerable, owing to frequent cut banks and ravines, and it is questionable whether the timber interests alone would warrant the construction of such a road.

Demand.—At present, excepting possibly in the extreme northwestern part of the reserve, timber has no market value where it stands. Prices at the nearest mill, Columbia Falls, are $3 per M, and fuel, at present, hardly commands any stumpage.

Agricultural land.—While some vegetables and hay would doubtless grow in favorable spots throughout the valley, the liability of destructive frosts at any time during the season precludes the possibility of commercial agriculture. Perhaps 80 square miles are level enough to be arable, but much of this is gravelly and unsuitable for agriculture except for garden spots, to supply lumber or mining camps, in case of special need.

Irrigation.—Very little water, indeed, will ever be used for irrigation in this valley, but it is possible that it may be used in the Flathead Valley outside of the mountains, where agriculture, though carried on at present without irrigation, would be improved by it.

Occupancy.—There are about half a dozen cabins in the valley, but these are not occupied all the year. They belong to prospectors, who use them only while doing their assessment work.

Water power.—Water power is abundant along the main stream and three of the tributaries. Spotted Bear and two streams from the west are large enough to furnish power for sawmills. There are several very favorable sites for dams, and large amounts of water could be held above the canyons.

Mining.—No ore has been shipped from the valley, but several claims are held in the lower portion for coal, gold, silver, and copper.

SWAN-CLEARWATER VALLEY.

Topography.—This tract, having an area of about 728 square miles is about 59 miles long and varies from 8 to 16 miles wide. The Mission Range on the west and the Kalispell Range on the east are high and sharp, and the low lands, increasing in width above the lakes, are undulating to rolling, and remarkably uniform in general topographic features.

Rock.—While outcroppings of limestone and quartzite, underlain by green schists, are almost continuous along the bordering mountain ranges, no outcrops were found in the bottom of the valley. There are certainly very few there. The bowlders of the valley are in general of the same material as found in place on the mountain sides, whence they have been brought by glacial action.

Soil.—About the head of Swan Lake clays are prevalent and reach continuously some distance up the valley, as far as Soup Creek. Above this point, both up Swan River and its lateral tributaries, the soil is greatly varied, though in general a glacial till, with beds or banks of bowlder clay, and morainic ridges reaching out of the mountain gorges. The material left by the glaciers has been considerably modified by the later action of the water, especially near the river. A short distance above Lion Creek, or about 16 miles in a direct line above Swan Lake, sand and gravel become more prevalent over the general surface, and instead of large bowlders and finer sediments, as found to the northward, there are south of this point ridges and mounds of sandy and gravelly material with intervening meadows, often without surface drainage. Occasionally clay tracts are found in this portion of the valley, but this clay does not seem more productive than the sand. It is, in fact, sometimes found nearly barren. The "big burn," having an area of about 5 square miles, about 28 miles above the lake, has a clayey soil, and is only about half covered with vegetation (lodgepole pine).[1]

In proceding southward above the "big burn," little other than sandy or gravelly land was seen, except in the bluffs along water courses. As regards productiveness, the lower portion of the valley, or that within 16 miles of Swan Lake, which is more clayey, has with few exceptions a heavy covering of vegetation. This is in contrast with the lands of the upper valley, where the rather scant covering of larch and lodgepole pine at first gives the impression of a very poor soil, but upon close examination it is found that the sparseness of tree growth is largely due to frequently occurring fires which have thinned the forest. The soil of the upper portion of the valley is really better than one would consider it is in passing hastily through it.

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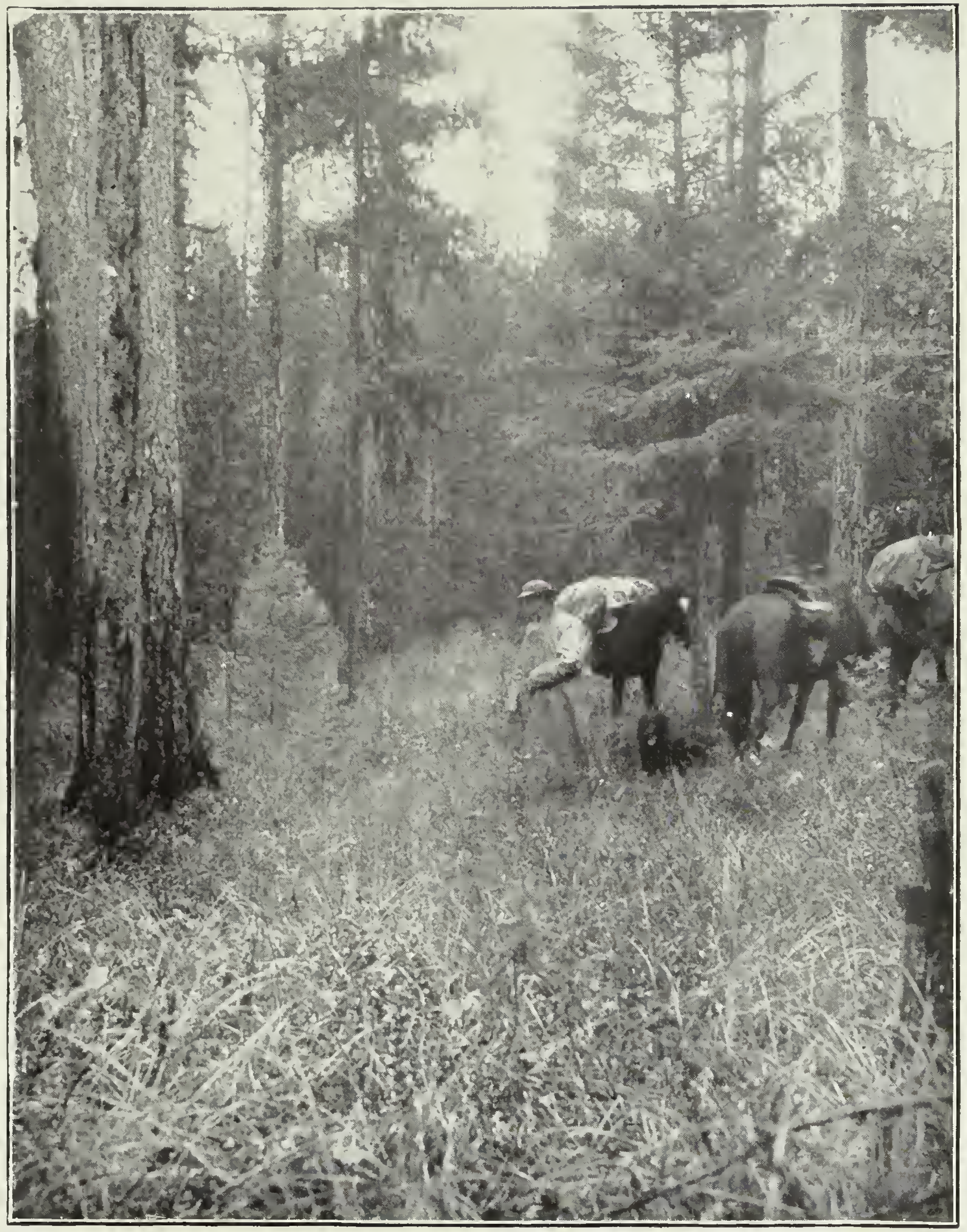
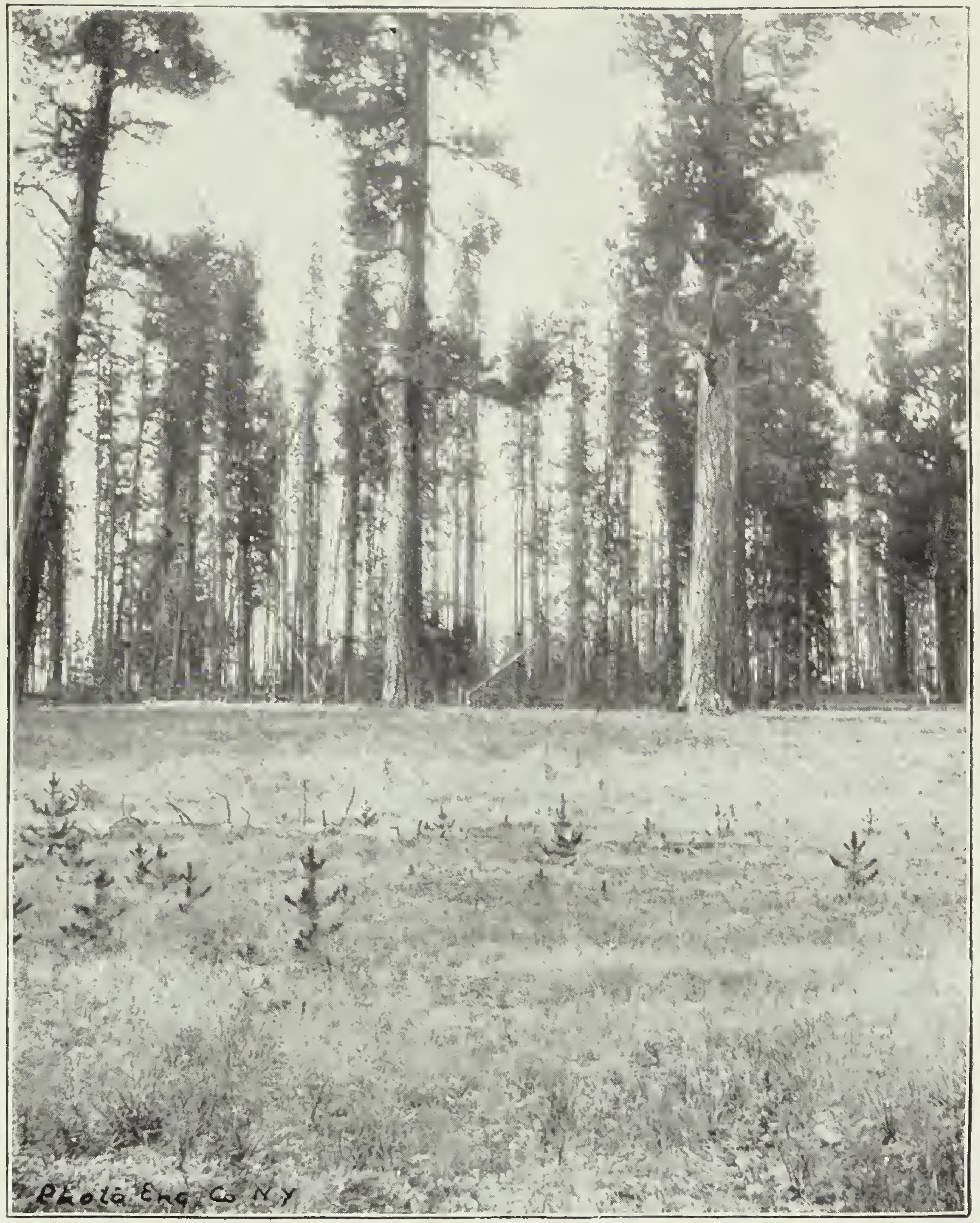
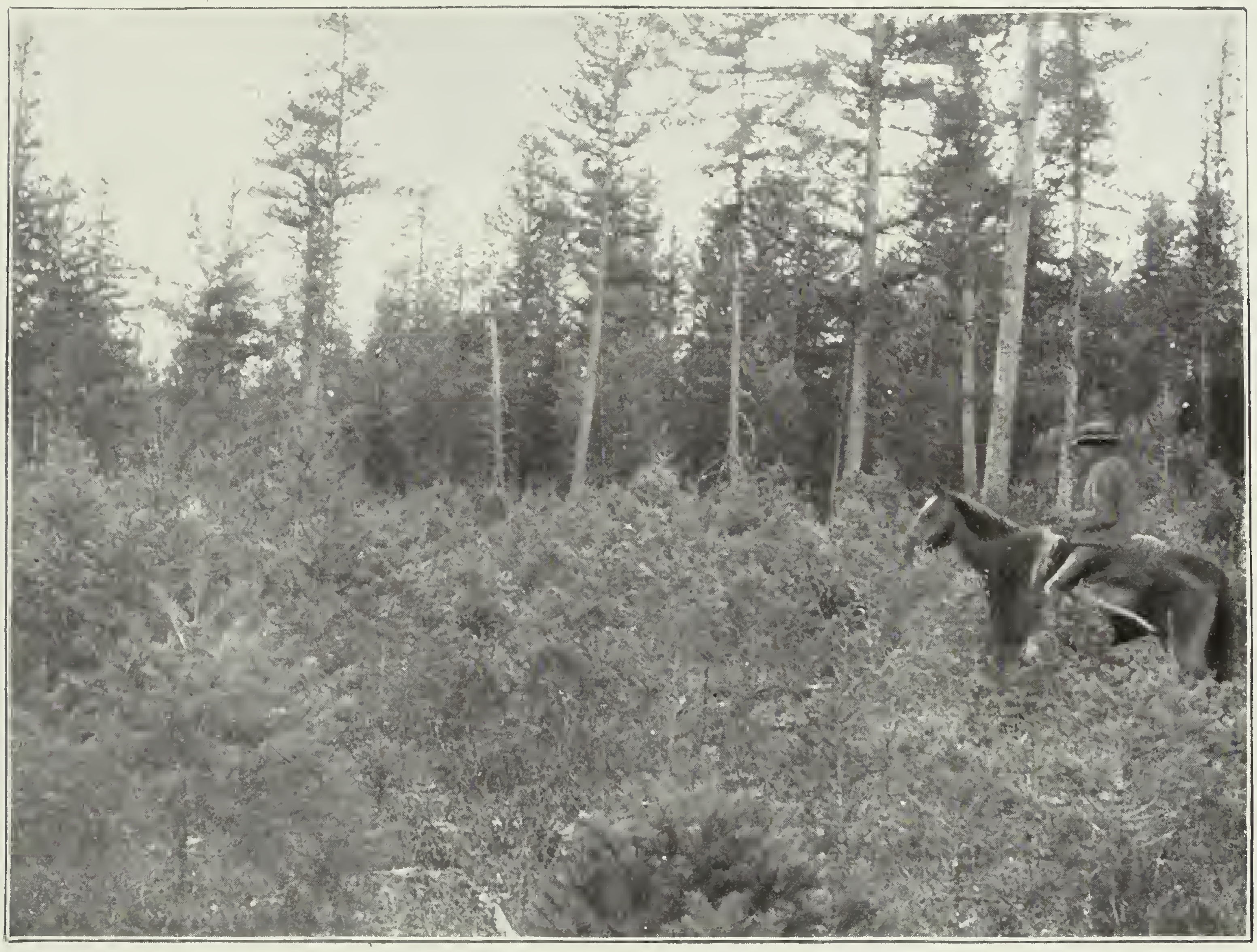
[1] The condition of this land is very much like the tract noted in the year 1898, on the North Fork of Flathead River, and the cause of such barrenness invites study.



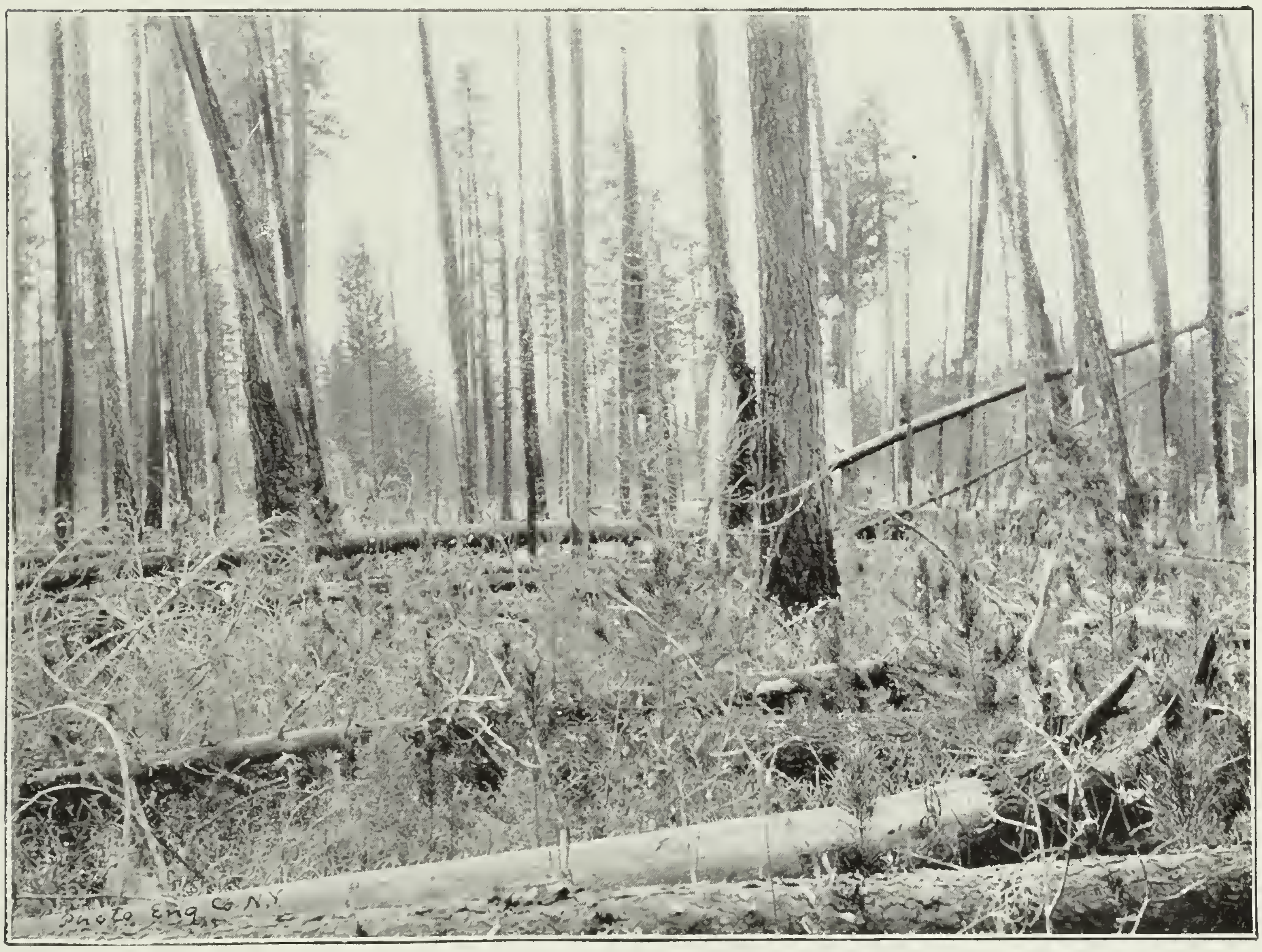
A. EFFECT OF MODERATE FIRES; SURVIVING LARCH WITH UNDERGROWTH OF LODGEPOLE PINE, RED FIR, AND LARCH.



B. LARGE YELLOW PINE, SUBORDINATE LODGEPOLE, JOCKO TRAIL, NEAR PLACID LAKE.



A. STUMP LAND IN T. 26 N., R. 19 W., RESTOCKED DENSELY WITH RED FIR.



B. LARCH AND LODGEPOLE PINE ON BURN OF 1889.

Subsoil.—Bowlder clay and gravels, as usual in these once glaciated mountain valleys, constitute the greater portion of the subsoil. For about 16 miles above Swan Lake, however, a depressed, narrow strip in the central portion of the valley, which seems to have been occupied by the lake, has silts and fine alluvium, varied according to accidents in the work of streams that brought such material into the lake. Outside of this depression, however, both between it and the mountains, and in the valley above, or south of it, the recent deposits of fine material are not abundant, and bowlder clays, gravels, sands, and silts are almost the only subsoils.

Very deep beds of very porous gravel, which cause prairie openings common in many of the mountain valleys, because of too thorough subdrainage for trees, are not common, although the greater portion of the upper valley is so dry as to be adapted only to such dry-land trees as larch and lodgepole pine.

Humus.—Humus is light except in the lower portion of the valley, where it has been less burned and where it seems damper than above, or south of the old lake basin, which extends about 16 miles south of the present head of Swan Lake. Below the benches along the small streams there is frequently quite a depth of black earth, but in the morainic region nearer the mountains and southward across the main valley there is but little humus outside of the depressions that are so damp as to never burn deeply.

Litter.—Litter is correspondingly light where burns have been at all recent and abundant where the area is too damp to burn (see Pls. XXIII, *B*, and XXVI, *A*). Leaves and fine débris, however, have seldom accumulated to a depth of more than 3 or 4 inches. Probably three-fourths of the whole area of the valley has less than 2 inches of such litter, the scantiness of litter being due principally to fire.

Trees and timber.—The principal timber trees of the valley are larch, red fir, and yellow pine. Others that will yield a considerable amount are spruce, white pine, and lodgepole pine. Besides these are balsam, cedar, nut pine, hemlock, aspen, and cottonwood, of little commercial value, but possibly of use for some purpose.

In distribution the first three are confined to the valley bottom, the benches, and the lower foothills, and the nut pine and balsam are usually limited to the mountain ranges. The hemlock, cedar, and white pine are found only in sheltered, damp places, as in the ravines or on the lower mountain sides, and the cottonwood is confined to the banks of streams; otherwise the species are fairly well mixed, with perhaps the exception of spruce, which seeks constant moisture and avoids dry subsoil (see Pls. XXVI, *B*, and XXVIII, *A*).

In size the trees in this valley are hardly as large as in some other localities. The yellow pine, for instance, on the flat between Holt and Columbia Falls, reaches a diameter of 6 feet, even 7 feet on the stump, and a height of 150 feet, while above Swan Lake the largest trees noticed were about 4 feet in diameter and 100 feet high. Lodgepole pine was rarely seen over 14 inches in diameter and 70 feet high, while spruce is seldom found over 30 inches in diameter and 90 feet high (see Pl. XXVIII, *B*). Although constituting the greater portion of the growth on the higher mountain sides, it has a size suitable for log timber only in gulches or on other damp, fertile land. The amount of log timber in the valley, roughly estimated to 8-inch top, is as follows:

Log timber in Swan-Clearwater Valley, Montana.

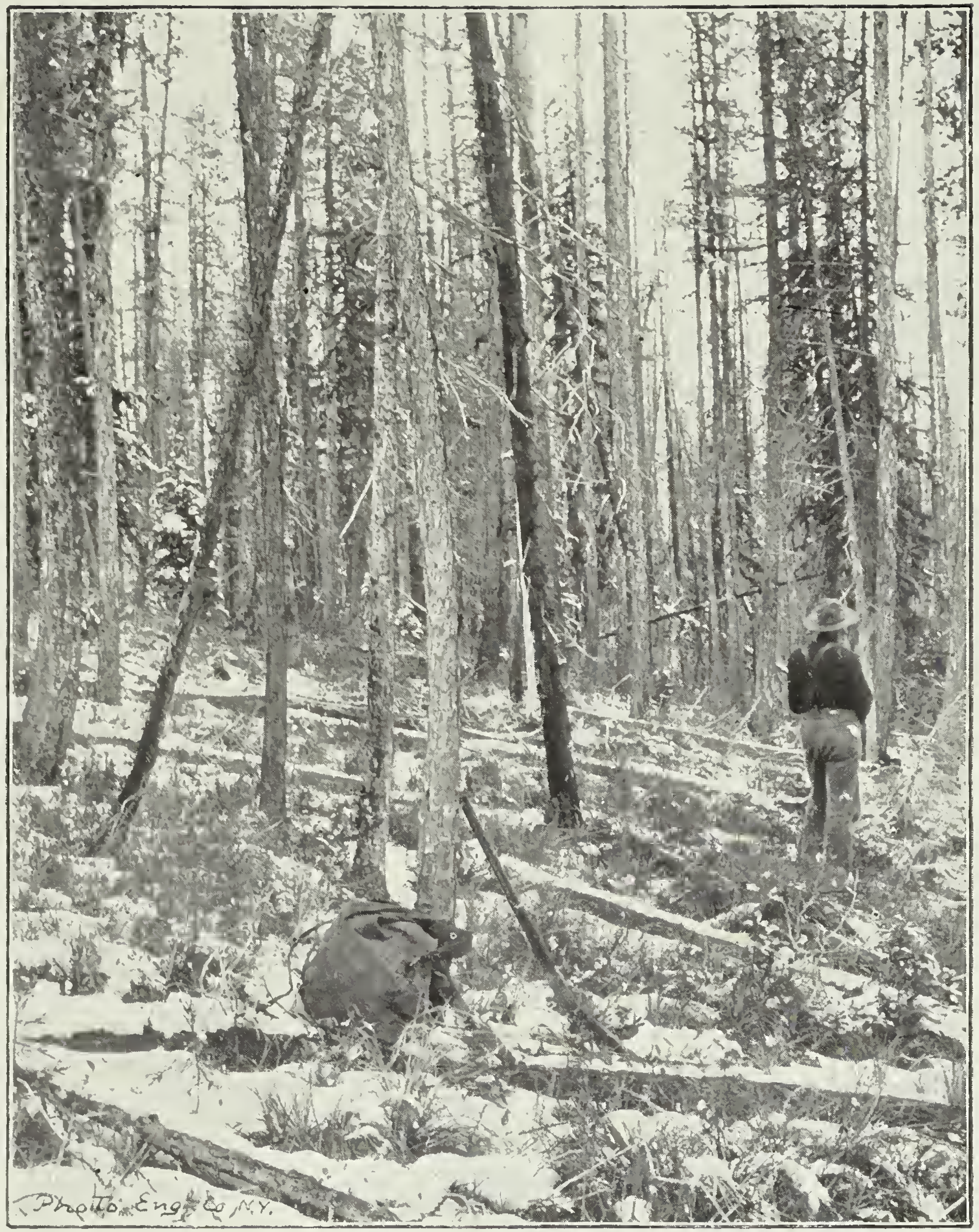
	M. feet B. M.
Larch	1, 050, 000
Yellow pine	100, 000
White pine	10, 000
Red fir	500, 000
Spruce	175, 000
Lodgepole pine	30, 000
Total	1, 865, 000

This estimate is regardless of accessibility, of present custom of cutting, and present demand. It is simply intended to express a safe estimate of the amount of log timber. For the whole amount of wood material in the valley there should be added that too small for log timber, which has been very roughly estimated in cords, as follows:

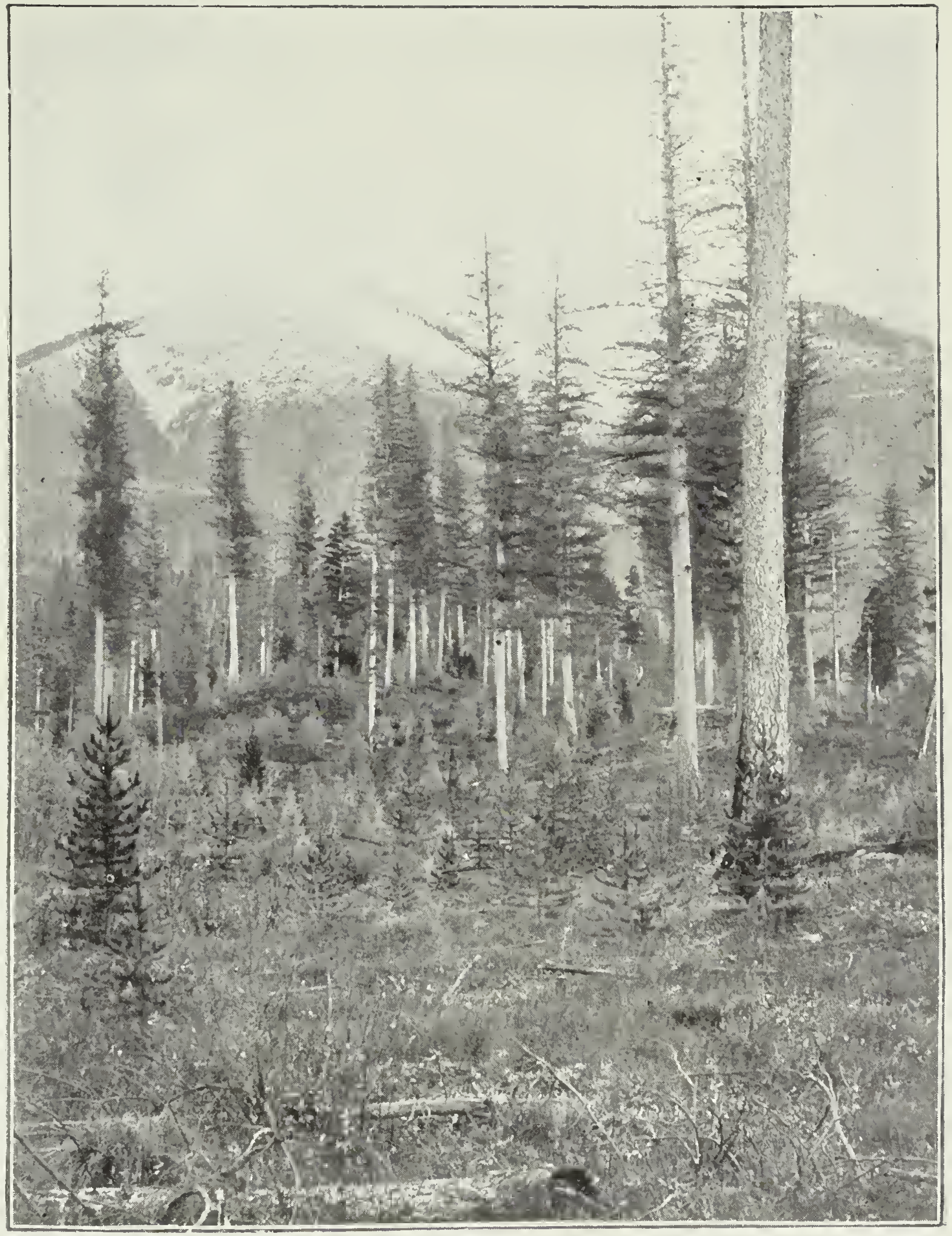
Timber in Swan-Clearwater Valley too small for log timber.

	Cords.
Larch	1, 200, 000
Lodgepole pine	1, 000, 000
Yellow pine	100, 000
Spruce	900, 000
Balsam	500, 000
Red fir	400, 000
Other species	560, 000
Total	4, 660, 000

Young or sapling growth.—This is abundant, except where repeatedly burned, and its volume is fairly represented by the number of cords in the table above. The lower portion of the valley especially is well stocked with spruce, red fir, and larch subordinate to large trees on the same land (see Pl. XXIV, *B*). The upper portion of the valley is characterized by its young stock of lodgepole pine and larch, while the mountain slopes, especially the western slope of the Kalispell Range, are brushy with alder, willow, and maple and only a sprinkling of larch, lodgepole pine, balsam, red fir, and aspen. In fact, the condition and distribution of the young growth is much affected by fire (see Pl. XXIX, *A*). It is not only thinned by it, but the composition of the forest is made very irregular, and we find it patched by stock of various ages and by areas imperfectly occupied, or occupied by species



A. MODERATE BURN IN LODGEPOLE PINE AND LARCH, MOUNTAIN RIDGE WEST OF NORTH END OF ELBOW LAKE.



B. YOUNG LARCH AND LODGEPOLE COMING IN AFTER FIRE UNDER SURVIVING LARCH, NORTH OF HOLLAND LAKE, LOOKING EAST TOWARD GORDON PASS.

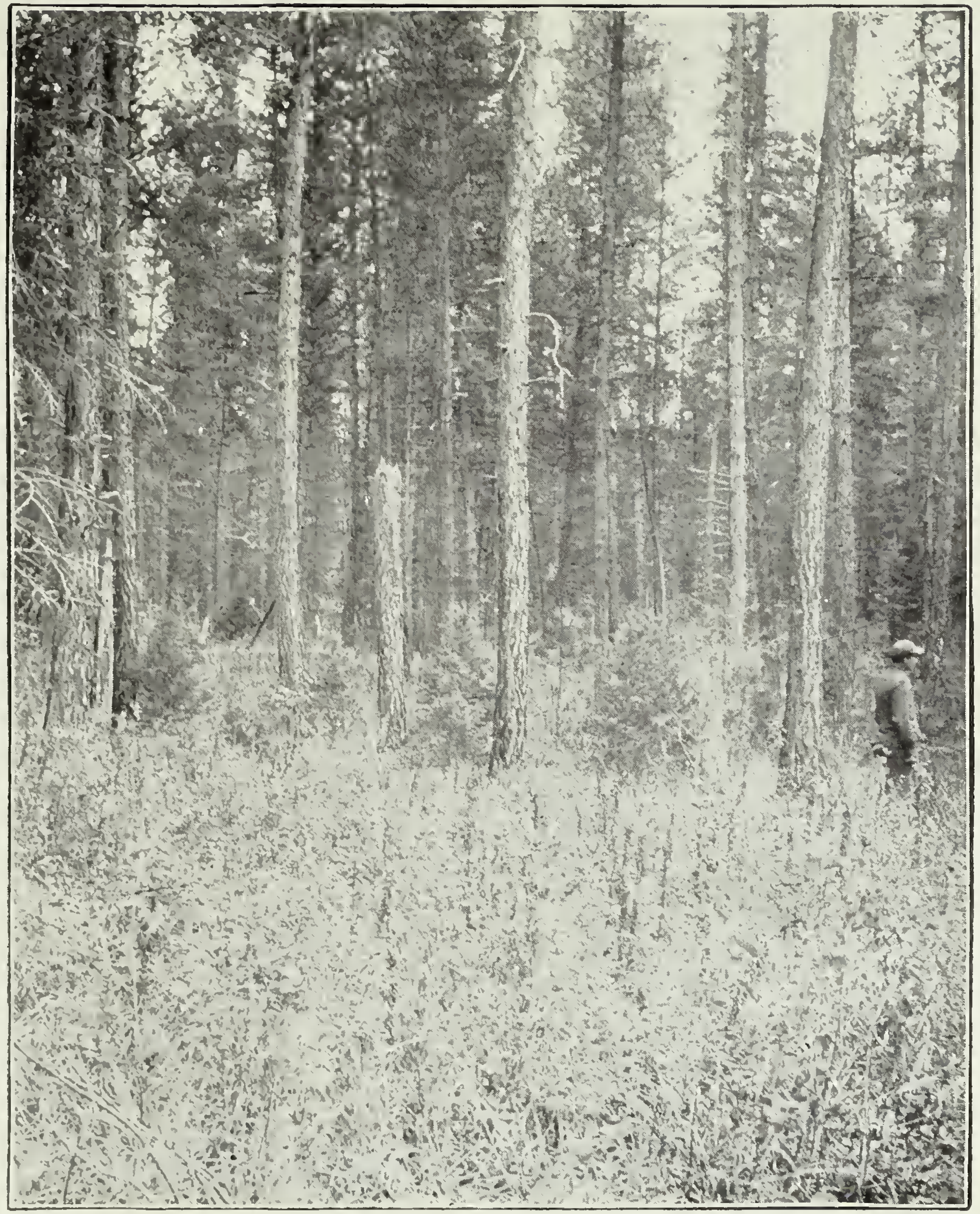
promising no value. As a rule the tendency in the valley is toward a stock of more valuable species. In the lower or northern portion spruce and red fir are coming in where the older trees subside, and in the higher or southern portion of the valley larch is becoming more abundant as the lodgepole pine is injured by fire. An exception to this general tendency is found on the more severely burned portions. These almost invariably have been preempted by lodgepole pine in varying degrees of density, often to be completely denuded by succeeding fire (see Pl. XXX, *B*). The yellow-pine lands, both about the headwaters of Swan River and in the Clearwater drainage, are, as usual, more free from young stock than the forests of other species, yet some of these tracts have a fair sprinkling of red fir, larch, and spruce coming in underneath the pine (see Pl. XXX, *A*). As a rule these species do not reach tree size, being killed while small by repeated fires, while the yellow pine standing over them, protected by its thick bark, remains and furnishes favorable conditions for a new lot of seedlings, such as those just destroyed, to start again (see Pl. XXIX, *B*).

So much for the lowlands. The mountain sides have different tendencies. On them balsam and spruce compete with the lodgepole pine and larch, and toward the summits, or above 6,000 feet, usually crowd them out, especially in the gulches, although the combs and drier portions of the mountain spurs are frequently found with very few trees following the fire. Many areas, in fact, have nothing but brush, though not burned over during the past thirty years. In general, the valley is well stocked with saplings to constitute a new stock when the mature timber may be cut.

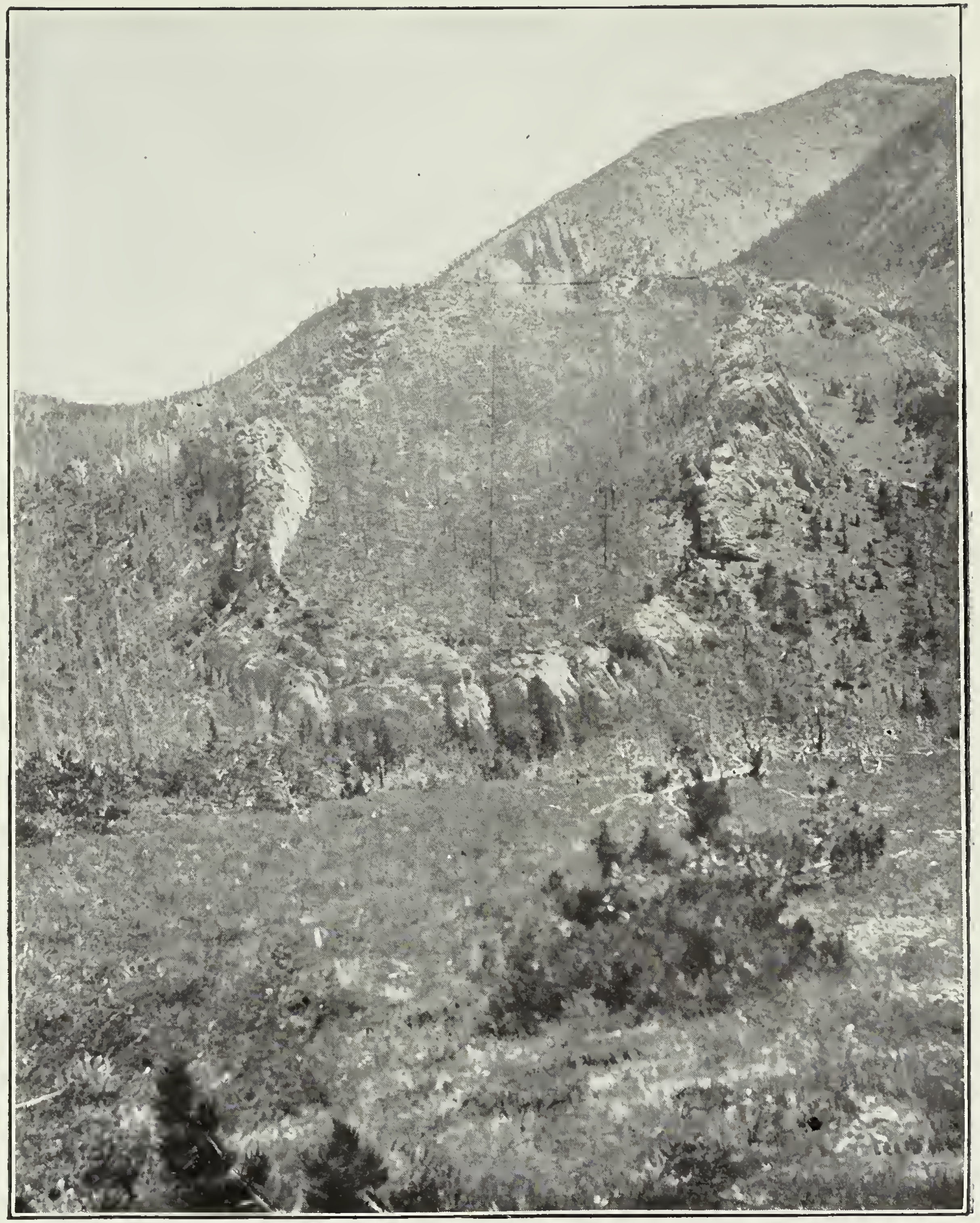
Underbrush.—The common bushes of the valley are alder, willow, dogwood, maple, mountain alder, spiræa, yew, redroot, and juniper. The first three, usually limited to wet places, especially along streams, often occupy smaller areas exclusively, but do not thrive as an undergrowth. Yew seems to be the only underbrush that forms a serious obstruction to travel with horses through the woods, and as the distribution of this shrub is not general, but is limited to ravines and gulches in the lower valley, underbrush here will be of minor importance in logging operations. It will still have a serious effect upon the composition of the forest, as burned areas are often first reoccupied by brush, which prevents immediate restocking with trees. Over a very large portion of the valley young trees form the principal undergrowth, and while these might be considered as underbrush, they have been described as young growth.

Fires.—Probably 90 per cent of the valley has been burned over within the past one hundred years, but evidences of such burns are so hidden by the forest left growing over them or grown since that it has been found impracticable to map all such areas (see Pl. XXXI, *A*). Only those are indicated on the map which have been recently and severely burned and on which evidence remains plain. After some forty years the trees killed by fire have usually fallen, the ground commonly has been reoccupied by forest and practically re-covered, and its character has changed from that of burn to woodland. Large areas, especially in the upper part of the valley, have been recently burned over without showing much effect of the fire, especially such effects as may be seen from a distance. While some 600 square miles of the valley have probably been burned over within the past one hundred years, only about 240 square miles, or approximately one-third of the whole area, are shown on the map as burned.

Reproduction.—The condition of these more prominent burns is varied. The mountains, especially on the western slope of the Kalispell Range, are either bare or scantily dotted with clumps of bushes or with strips of forest that have escaped fire because sheltered by rocks or water courses. About 6 miles below or north of Holland's ranch is a burn of about 6 square miles in area that has scarcely any other species than lodgepole pine following the fire. Reaching across the valley at this point, and occupying substantially all the land between the mountains above it, is a mixed forest of larch and lodgepole pine, the composition of which has been greatly modified by fire. The fires here have not, as a rule, been very severe. The greater portion of the larch has survived, and as most of the lodgepole pine has been killed the proportion of larch has greatly increased. Because of fires the great portion of the valley has now a network of fallen trees, either under a surviving portion of the original forest or under a new growth that has sprung up since the fire. Owing to the thickness of their bark the larger larch, red fir, and yellow pine trees endure fire better than other species and small trees. These are gradually gaining in proportion, while the lodgepole pine, except on the severest burns, is diminishing. On the yellow-pine lands the effect, while never harmless, is often hardly noticeable after the fire has passed. Such lands are seldom without small seedlings, and as a light fire is sufficient to kill and even consume them the evidence of damage done is difficult or impossible to find, even when, from the foresters' point of view, it is serious. The burns on the mountain sides, however, leave plain evidence to be seen for many years. The drought on these too thoroughly drained slopes is often so severe that all dead vegetable material burns readily, and even the smaller roots of living trees are consumed, leaving mountains almost entirely bare, to be restocked very slowly, indeed, if at all. The western slope of the Kalispell Range south of Swan Lake is now almost bare. The rarity of seeding years and of climatic conditions favorable to the germination of seeds in these high altitudes, especially on exposed slopes, has prevented restocking of trees, and even the reappearance of brush has been slow and imperfect. The western, or Mission Range, or the eastward slope



A. MIXED YELLOW PINE AND RED FIR IN T. 26 N., R. 19 W.



B. BURNT MOUNTAIN SIDE. SOUTH FORK OF BIRCH CREEK.

of it, has a much less barren appearance and has been much less burned. The burn about Crow Creek Pass was visited, and in ascending the mountain was found to be less well stocked with trees among the rather dense growth of alder, maple, willow, and huckleberry brush. Ascending farther and reaching an altitude of about 6,000 feet, few seedlings were seen other than balsam and Engelmann spruce. The usual tardiness of restocking on these mountain slopes makes plain the importance of keeping them stocked, and this can be done only by preventing fire. The effect of burns in causing a change of species is very noticeable over a wide area of nearly 100 square miles in the upper portion of the Swan River Valley. Here, while severe fires have killed all the trees on some small areas, the greater areas have been only moderately burned, yet severely enough to kill the most sensitive trees. Prior to the fire the stock was principally lodgepole pine, with which larch was mingled in varying proportions, usually about half. The fires have killed most of the lodgepole pine and left most of the larch, and now from the mountain side the forest appears nearly all larch, but in passing through it a dense network of fallen lodgepole pine is found under the larch, and growing up through this fallen material are, as a rule, young larch, although lodgepole pine reappears on the least shaded spots (see Pl. XXXI, *B*). This is a remarkable exception to the usual effect of fires upon the composition of the forest, as they generally increase the proportion of lodgepole pine.

Deadwood.—There is no deadwood of commercial value, as the difficulty of access renders it worthless where it is found. There are, however, in the valleys probably about 128,000 cords of deadwood that could be used for fuel or fencing were it brought to market. The greater portion of this deadwood is high on the mountain sides, principally west of Swan Lake.

Cutting.—No cutting has been done except for cabins, fences, roads, trails, and bridges.

Transportation.—The streams after improvement promise feasible transportation for about half of the timber. The remainder must be first hauled on cars or flumed to driveable water. The abundance of water power and uniform down grade available promise most economy by use of electric railways. The material in the Clearwater drainage would naturally be floated down the Blackfoot River, although there is no serious obstacle to building a railway across the divide and bringing all dead material down the Swan River, at the mouth of which is an admirable location for a large and permanent mill plant.

Demand.—At present stumpage values in this tract, and even on more accessible land northward in the Flathead Valley, are nominal. Good timber there goes for 75 cents to $1 per thousand feet on the stump. Within the reserve very little could be realized without extensive developments to make the timber more accessible.

Agricultural land.—Commercially, agriculture within the valley will never be important. Vegetables, small fruits, and hay, perhaps some grain, would grow, but only in a small way, and stimulated by the difficulty of bringing such material from outside. There are some 200 square miles in the valley that are smooth enough to be arable.

Grazing.—There are about a dozen small prairie openings in the valley, probably 500 acres of upland and the same area of slough. Snow evidently falls deep and lies long, but hay is plenty, and a few cattle may be kept with some care.

Occupancy.—There is no stock now in the valley except at Holland's, where there are about 30 horses and a dozen cattle. On Clearwater Lake Mr. Seeley has been living some time, and has recently erected a substantial house. About the head of Swan Lake are 4 resident squatters and on Flathead Lake are 11. Scattered through the valley are 15 cabins, none of which were found occupied, though 2 of them were locked and evidently used at times.

Water power.—Below Swan Lake are many fine water powers on the large and constant outlet of the lake. The smaller streams above the lake, excepting Holland Creek and the outlet of Long Lake, are of uncertain value, as they become quite low in autumn, although strong in spring. Holland Creek and the outlet of Long Lake having natural reservoirs, are much more steady and may be greatly improved for water power by building dams at the outlet of the lakes.

Mining.—There are no mining operations at present, and no prospects were found or heard of on which assessment work was being done.

MOUNT RAINIER FOREST RESERVE, WASHINGTON

BY

FRED G. PLUMMER

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MOUNT RAINIER FOREST RESERVE, WASHINGTON.

By Fred G. Plummer.

BOUNDARIES.

By proclamation of the President made February 22, 1897, the Mount Rainier Forest Reserve was established with the following boundaries:

Beginning at the southeast corner of township four (4) north, range (9) east, Willamette base and meridian, Washington; thence northerly along the range line between ranges nine (9) and ten (10) east, subject to the proper offset on the first (1st) standard parallel north, to the northwest corner of township six (6) north, range ten (10) east; thence easterly along the township line to the northeast corner of said township; thence northerly along the range line to the northwest corner of township seven (7) north, range eleven (11) east; thence easterly along the township line between townships seven (7) and eight (8) north to the northeast corner of township seven (7) north, range twelve (12) east; thence northerly along the surveyed and unsurveyed range line between ranges twelve (12) and thirteen (13) east, subject to the proper offset on the second (2nd) standard parallel north, to the northwest corner of township eleven (11) north, range thirteen (13) east; thence easterly along the surveyed and unsurveyed township line between townships eleven (11) and twelve (12) north to the southwest corner of township twelve (12) north, range fifteen (15) east; thence northerly along the surveyed and unsurveyed range line between ranges fourteen (14) and fifteen (15) east, subject to the proper offsets on the third (3rd) and fourth (4th) standard parallels north, to the point for the northeast corner of township eighteen (18) north, range fourteen (14) east; thence westerly along the unsurveyed and surveyed township line between townships eighteen (18) and nineteen (19) north to the southwest corner of township nineteen (19) north, range seven (7) east; thence southerly along the surveyed and unsurveyed range line between ranges six (6) and seven (7) east, subject to the proper offsets on the township line between townships seventeen (17) and eighteen (18) north, and on the fourth (4th), third (3rd), and second (2nd) standard parallels north, to the point for the northeast corner of township five (5) north, range six (6) east; thence westerly along the unsurveyed township line between townships five (5) and six (6) north to the southeast corner of township six (6) north, range four (4) east; thence southerly along the unsurveyed range line between ranges four (4) and five (5) east, subject to the proper offset on the first (1st) standard parallel north to the point for the southwest corner of township four (4) north, range five (5) east; thence easterly along the unsurveyed and surveyed township line between townships three (3) and four (4) north to the southeast corner of township four (4) north, range nine (9) east, the place of beginning.

Excepting from the force and effect of this proclamation all lands which may have been prior to the date hereof embraced in any legal entry or covered by any lawful filing duly of record in the proper United States land office, or upon which any valid settlement has been made pursuant to law, and the statutory period within which to make entry or filing of record has not expired, and all mining claims duly located and held according to the laws of the United States and rules and regulations not in conflict therewith:

Provided, That this exception shall not continue to apply to any particular tract of land unless the entryman, settler, or claimant continues to comply with the law under which the entry, filing, settlement, or location was made.

GENERAL DESCRIPTION.

The tract thus reserved includes the Cascade Range in the southern part of Washington. The Government land surveys which partly bound and fix the location of the reserve have in western Washington been made from the Willamette meridian and in eastern Washington from the Columbia guide meridian. The sum of the discrepancies between them falls in the unsurveyed mountainous region partly covered by the reserve, and for this and other reasons the area of the reserve is 2,146,600 acres, and not 2,234,880 acres, as would be implied by the above description if all the townships were of full size. Of this total area 890,440 acres, or 41.4 per cent, lies on the eastern slope, and 1,256,160 acres, or 58.6 per cent, on the western slope of the mountains.

These two slopes, which will be often referred to in this report, present widely divergent conditions in climate and flora, but they share a bold topography in common. The line dividing these slopes, or the line separating the eastern drainage from the western, has a general direction of N. 5° E. Its detailed meanderings within the reserve are delineated on the map, Pl. XXXIII.

All of the eastern slope and the greater portion of the western drain into Columbia River, the tributary streams being the Cowlitz, Cispus, Lewis, Washougal, Rock, Wind, Little White Salmon, White Salmon, Klickitat, Atanum, Tieton, Naches, and Yakima rivers. The total watershed area of these streams is 1,794,600 acres, or 83.6 per cent of the reserve. The remainder, 352,000 acres, or 16.4 per cent, is drained into Puget Sound, the tributary streams being the White, Puyallup, and Nisqually rivers.

Within the reserve are four mountain peaks or domes of unusual magnitude: Mount Rainier, 14,526 feet; Mount Adams, 12,470 feet; Goat Mountain, 8,500 feet, and Mount Aix, 7,623 feet. Of these Mount Rainier and Mount Aix are not on the summit line, but like Mount St. Helens, Mount Stewart, and Mount Baker, all in Washington, stand on one side or the other of the range.

The glaciers and perpetual snow fields of Mount Rainier have a total area of 32,500 acres, and are therefore an important item in the estima-

A. MOUNT RAINIER AND LONGMIRE SPRINGS.

B. MOUNT RAINIER.

tion of areas without timber. The glaciers of Mount Adams cover only 2,300 acres, and those of Goat Mountain are insignificant. In unusual summer seasons, such as that of 1899, small areas of high altitude, protected from the warm chinook winds, may remain snow covered, but the perpetual snow fields and glaciers within the reserve are limited to Mount Rainier and Mount Adams. Probably an exceptionally warm season would leave no ice or snow on Goat Mountain.

The routes of travel in the reserve are few. Most of the trails shown upon the map are hardly deserving of the name, but indicate blazed lines where better progress can be made than by taking a course through the timber and brush. The Indian's policy was to go only where his pony could take him, and the idea of cutting and logging out a trail was repugnant to him; therefore his lines of travel were along the sparsely timbered ridges, where feed was generally plenty, where game abounded, or where huckleberries grew. Later came the prospectors and sheepmen, and in some places they did considerable work. Since the advent of settlers in the valleys of the Nisqually, Cowlitz, Wind, and Little White Salmon, wagon roads have been built and the larger streams bridged. Since 1896 stages have run from Tacoma to Longmires Springs during July, August, and September of each year to accommodate the tourist travel en route to Paradise Park. Twelve miles of this stage road is inside of the reserve and was constructed on a county survey prior to the proclamation of the reservation. Public sentiment strongly favors the opening of this scenic region by better lines of travel than the poor wagon road and pack trails. The Yellowstone and Yosemite will have a strong competitor when this is done. The setting aside of nine townships around Mount Rainier as a national park was an act which met with universal approval.

CLIMATE.

Accurate meteorological data are not obtainable regarding that portion of the Cascade Mountains within the boundaries of the reserve, as the Weather Bureau has never had an observer in that area. During the examination a large amount of fragmentary information was collected from settlers, prospectors, and trappers, and by personal observation. This has been used, with many interpolations, in the preparation of the accompanying maps.

The bold topography of the reserve is the cause of wide diversities in climatic conditions, some of which are general and affect large areas, while others affect only small areas. The rain-bearing clouds are brought by southwest winds from the Pacific Ocean, and find easy access to the Cascade Range through breaks in the Coast Range. The mountains along the coast, owing to their position and height, are great rain producers for their own areas, but the range is not continuous and the gaps in it are low. Important among the gaps, as affecting the region under consideration, are those made by Grays Harbor, Willipa Bay, Columbia River, Tillamook Bay, and Yaquina Bay.

The Cascade Range, running north and south, parallel with the coast, presents a more continuous barrier to the rain-bearing clouds, the only break or gap being that through which Columbia River flows.

The winters in the mountains are long rather than severe. Doubtless upon such elevations as Mount Rainier, Mount Adams, or Goat Mountain the prevailing conditions during the winter are of extreme severity.

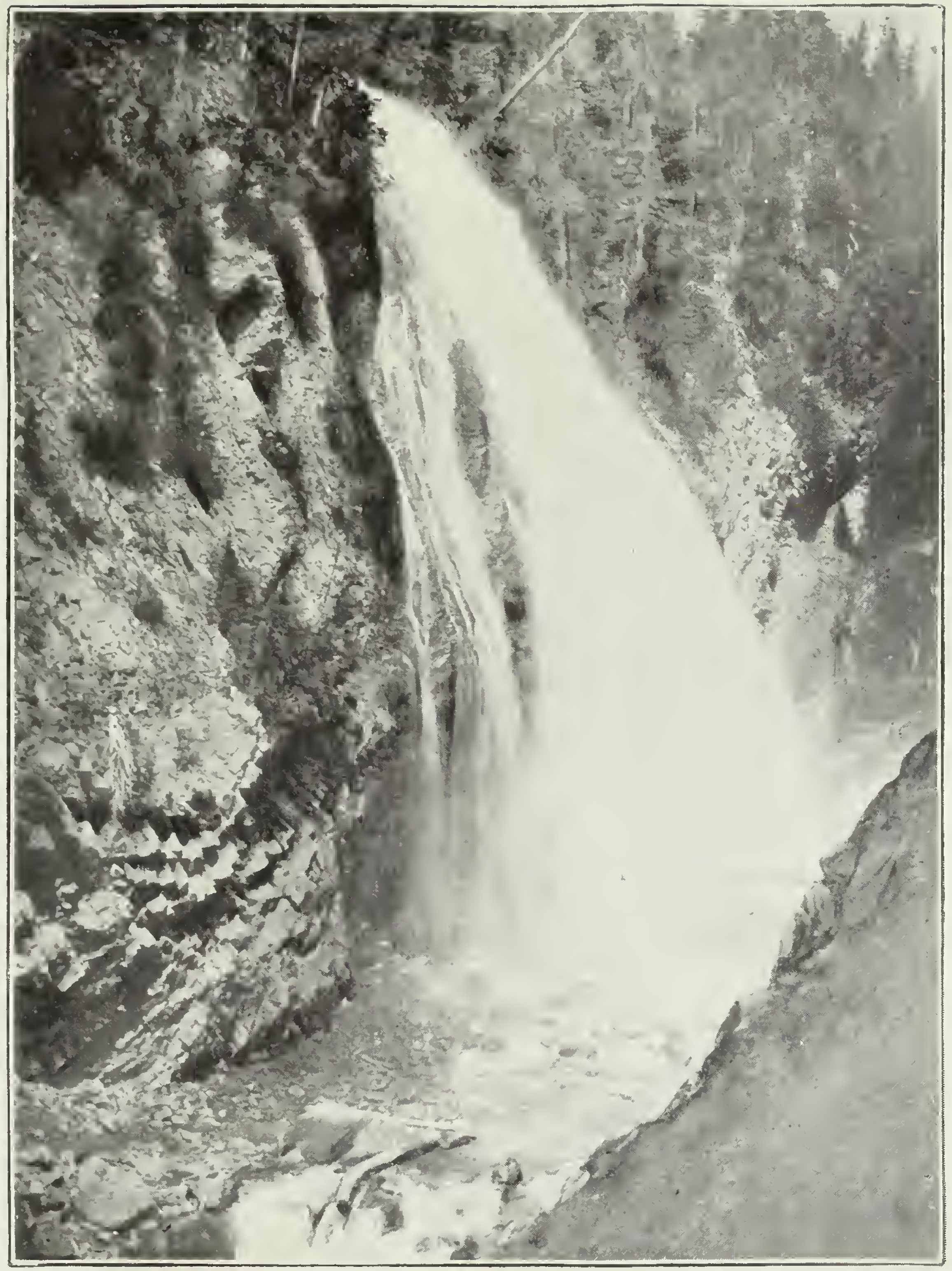
A strong contrast is presented between the corn and tobacco fields of the Cowlitz Valley and the ice fields and glaciers of Mount Rainier, and yet among these same glaciers in the mountain parks a profusion of wild flowers and grasses results from the mild and delightful climate that prevails during the short summer season. It is always a matter of surprise to the tourists that they may camp in summer gardens surrounded by arctic scenery on such a grand scale, but this camping season is limited to July, August, and September.

During 1886, 1887, and 1888 the engineer department of the Northern Pacific Railway kept a weather record at Stampede Pass tunnel, and from those observations the following table has been compiled:

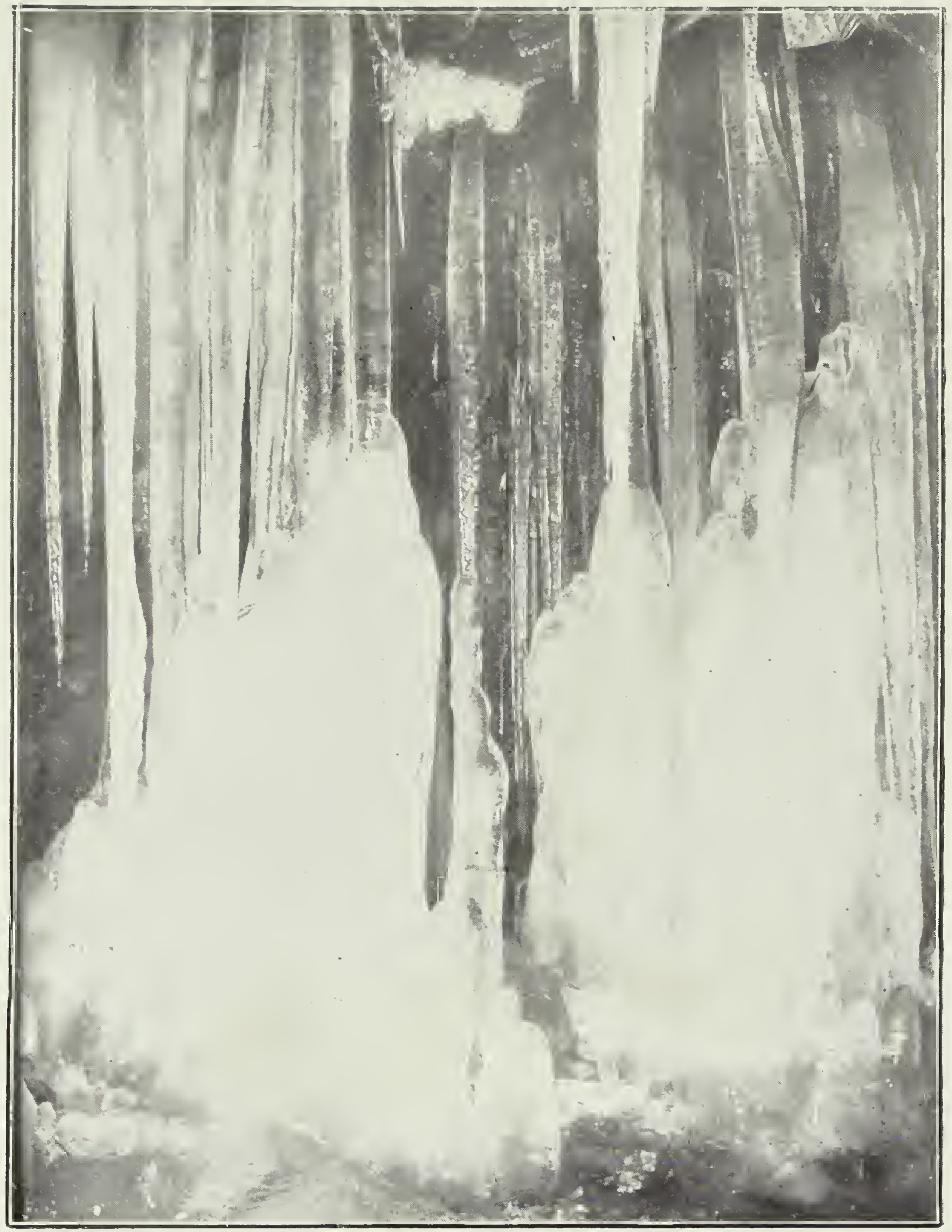
Average temperature and snowfall at Stampede Tunnel, Washington, for 1886–1888.

[Altitude, 2,840 feet.]

Months.	Greatest depth of snow.	Temperature.	
		Highest.	Lowest.
	Feet.	*Degrees.*	*Degrees.*
January	8.9	42	10
February	7.5	47	16
March	7.5	55	20
April	5.5	61	41
May	2.6	77	35
June	....	72	43
July	....	86	48
August	....	82	51
September	....	76	40
October	.2	62	32
November	1.1	50	19
December	3.6	42	18



A. NARADA FALLS, PARADISE PARK.



B. ICE CAVES.

ARABLE LANDS AND SOIL FORMATIONS.

Only about 45,000 acres or 2 per cent of the entire reserve is fair farming land, and of this amount more than one-half is under adverse climatic conditions due to great altitude and exposure.

Of the favorably situated areas in western Washington the most important is the Cowlitz watershed.

The Cowlitz Valley widens for a length of 13 miles within the reserve and includes some very good land known as the "Big Bottom," which contains about 12,000 acres, of which 25 per cent is slashed and partly cleared. The soil formation, as shown by the wells and river banks, averages as follows:

Section in Cowlitz Valley, Washington.

	Feet.
Sand or sandy loam	1.0
Scoria sand	.5
Sand and sandy loam	12.0
Gravel and sand	4.0
Scoria sand	2.0
Clay and sand.	

Bear Prairie, in sec. 8, T. 14 N., R. 8 E., at the head of Snake Creek, in the same watershed, contains about 90 acres of good hay land and has been drained by the claimant. The formation as shown by the ditching is as follows:

Section in sec. 8, T. 14 N., R. 8 E., Washington.

	Feet.
Sandy loam	1.0
Scoria sand	.1
Sandy loam	1.25
Scoria sand	1.0
Sandy loam.	

The Nisqually below the mouth of Horse Creek has an area of about 4,000 acres, of which 30 per cent is a liberal estimate of the arable portions. The balance of the bottom lands are either rocky, gravel, or clear-washed sands, with little soil or humus. The areas which are arable are covered with thick stands of forest and it costs $100 to $150 per acre to prepare them for the plow. The settlers on these lands often leave the stumps in their fields and garden patches.

On the South Fork of Puyallup River, on which no settlement has been made, there are about 300 acres of arable land in scattered patches which would be difficult to clear.

The Mowich River bottom inside the reserve has about 1,000 acres of very fair land which is heavily timbered.

The Carbon River Canyon is uninviting to the farmers. The steep side hills run almost to the river and a few little patches of good soil are all that can be mentioned. The same is true of the White River Canyon.

In the valley of Cispus River, below the mouth of Anatass Creek, there are about 1,000 acres of arable bottom and bench lands in scattered tracts. The same scoria sand found in the Cowlitz and other watersheds is present. In sec. 2, T. 11 N., R. 7 E., a well 5 feet deep in a swale showed the following:

Section in sec. 2, T. 11 N., R. 7 E.

	Feet.
Scoria sand	1
Black muck	4
Coarse sand.	

The valley of the Lewis River within the reserve is a canyon at its lower end, and those areas nearer the headwaters are of too great altitude to be of any use.

Wind River Valley is low and broad and contains about 8,000 acres of good land but difficult to clear. Being easily accessible from Columbia River, this area has found many settlers.

The same is true of the valley of the Little White Salmon River, which contains about 2,000 acres. The timber is smaller and has been partly removed by logging and railroad-tie cutting. In the White Salmon River Valley about 2,000 acres might be made profitable by irrigation, but the season would be short.

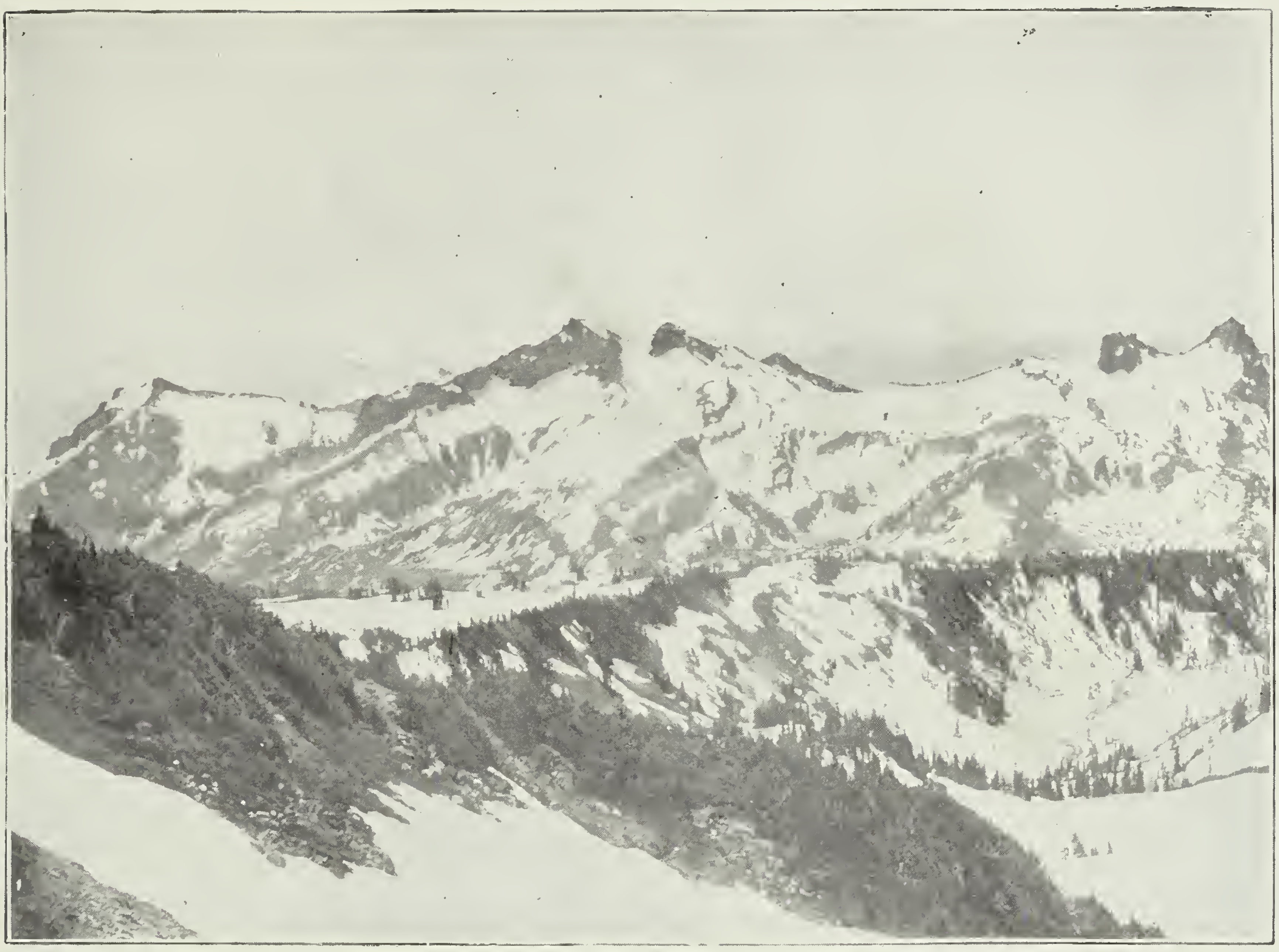
In the Klickitat watershed lying between the Fish Lake Stream and the Clearwater is about 2,500 acres of moist bench land. It would cost $75 per acre to prepare it for the plow, and by reason of the severe winters and short summers it would be of doubtful value. Bordering the Klickitat and the Lower Fish Lake Stream in Ts. 8 and 9 N., R. 12 E., there is an area of about 10,000 acres of bench land supporting a growth of yellow pine (*Pinus ponderosa*) and pine grass (*Calamagrostis suksdorfii*). When cleared it would be fair land under irrigation.

On the headwaters of the main Klickitat River are a series of meadows which will aggregate about 800 acres. The level bottom and low benches of fair land bordering these meadows may be classed as arable land and will add 1,200 acres to the above, making a total of 2,000 acres. These bottoms are divided transversely by several low ridges both in appearance and formation strongly suggestive of terminal moraines of an ancient glacier. No striæ were noted.

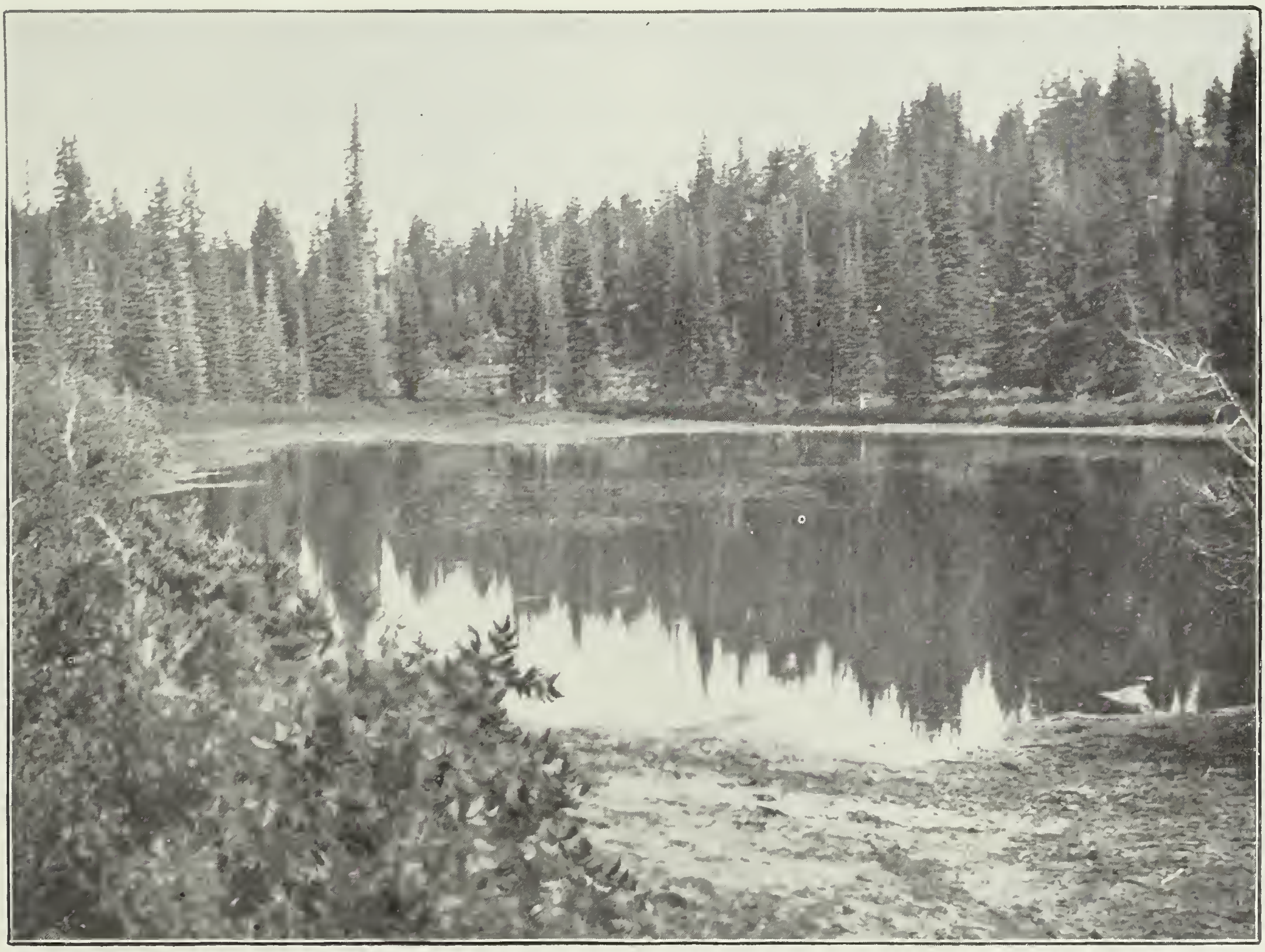
Conrad Meadows, on the South Fork of Tieton River, contain about 100 acres which should be drained.

At the head of Tannum Lake on Bumping River is about 500 acres of bottom land with a growth of young fir, hemlock, cedar, and light underbrush. Small areas of this bottom are timberless and grassed.

Other small and unimportant areas of arable land are Goose Prairie on Bumping River and Pleasant Valley on American River, and also a few benches and small lake beds on the Naches and Tieton rivers.



A. TATOOSH RANGE; MOUNT ST. HELENS IN DISTANCE.



B. SMALL LAKE NEAR INDIAN RACE TRACK; SECOND GROWTH OF MOUNTAIN FIR AND HEMLOCK.

Near the headwaters of many of the smaller streams are small meadows, but their elevation and exposure forbid their use for agricultural purposes.

The surface soils other than above detailed are entitled to only brief mention. The bold topography of the area prohibits the accumulation of deep or rich soils. The underlying ledges, talus, and gravels are covered with sand, resulting from decomposition, and over many areas with scoria. This scoria is both of interest and value. Some samples were taken from an undisturbed bank on a hill in the SE. ¼ of SE. ¼ of sec. 18, T. 12 N., R. 7 E., and gave a weight of 49.55 pounds avoirdupois per cubic foot. After being screened a cubic foot of the sand, whose grains ranged in size from one-half to one-eighth inch in diameter, weighed 43 pounds. The same screening after being dried weighed 37.4 pounds.

This sand follows the surface of the country, and in the higher elevations is often exposed, and over small areas has been recently eroded. Its color is a dull straw, sometimes deep brown. It is very coarse, gritty, and free from loam and other foreign matters, and is never waterworn. It is always loose, never compact. When exposed to air by the plow it undergoes a slow slaking process, and is regarded as remarkably fertile soil. In Cowlitz Valley John Blankenship says his field of sand changed very much by working, as it decomposed, turned yellow, and made good soil, which he has used for growing artichokes. His flower garden blooms freely, but the plants are not thrifty. Scoria sand taken from his well was thrown over the surface of the ground, and showed its fertility by the growth of weeds which followed.

All of the evidence presented by the scoria sand points to the probability of its being the result of a recent volcanic eruption, but to name the volcano or to fix the date will require more extended examination.

COAL INDICATIONS.

The Columbia River lava (Miocene) has overcapped and almost completely buried the coal-bearing strata (Eocene) within the reserve. Rarely has erosion uncovered the upper measures, which are found badly faulted and broken, and in several cases metamorphosed by heat.

Eocene sandstone and fossil-bearing shales were recognized near the southwest corner of sec. 18, T. 17 N., R. 8 E.; also on Goat Creek, Coal Creek, and Sweetwater Creek on the Nisqually watershed. The fossils are the leaves of alders, maple, and willow and resemble those found in the roof rocks of the Roslyn coal mine in eastern Washington and in other coal mines on the west side of the range. Coal float was found at these localities. Fossil leaves are also reported from the Wind River watershed, near Lookout Mountain.

The Davis coal prospect on Summit Creek has been worked to a small extent to determine its value. A vein 6 feet wide is claimed, which crosses Summit Creek, and is exposed on both sides of the canyon. The improvements consist of two small cabins, a shaft about 10 feet deep, and two tunnels.

Coal veins exist in secs. 13 and 14, T. 12 N., R. 8 E., and some prospecting has been done, but the work has been abandoned. Two miles north of Packwood Lake several small coal veins have been prospected.

On the headwaters of Cispus River, in T. 10 N., R. 10 E., several coal veins have been prospected, but no real development work has been done. Traces of coal have been found underlying the basalt at Steamboat Mountain.

MINERALS AND MINING CLAIMS.

The Columbia River lava is not a favorable formation for the deposition of the precious metals in paying quantities, although waters slightly charged with minerals have deposited gold, silver, lead, iron, and silica along cleavage planes in the high country rock, which is mainly diabase capped with lava. On the surface where these infiltrations occur the original sulphide deposit has been oxidized and concentrated, so that by panning some color of flour gold can be obtained. Below the line of oxidation, at a depth of about 30 feet, the mineral deposit changes to low-grade iron pyrites, which requires smelting and is not of sufficient value to make it profitable to mine.

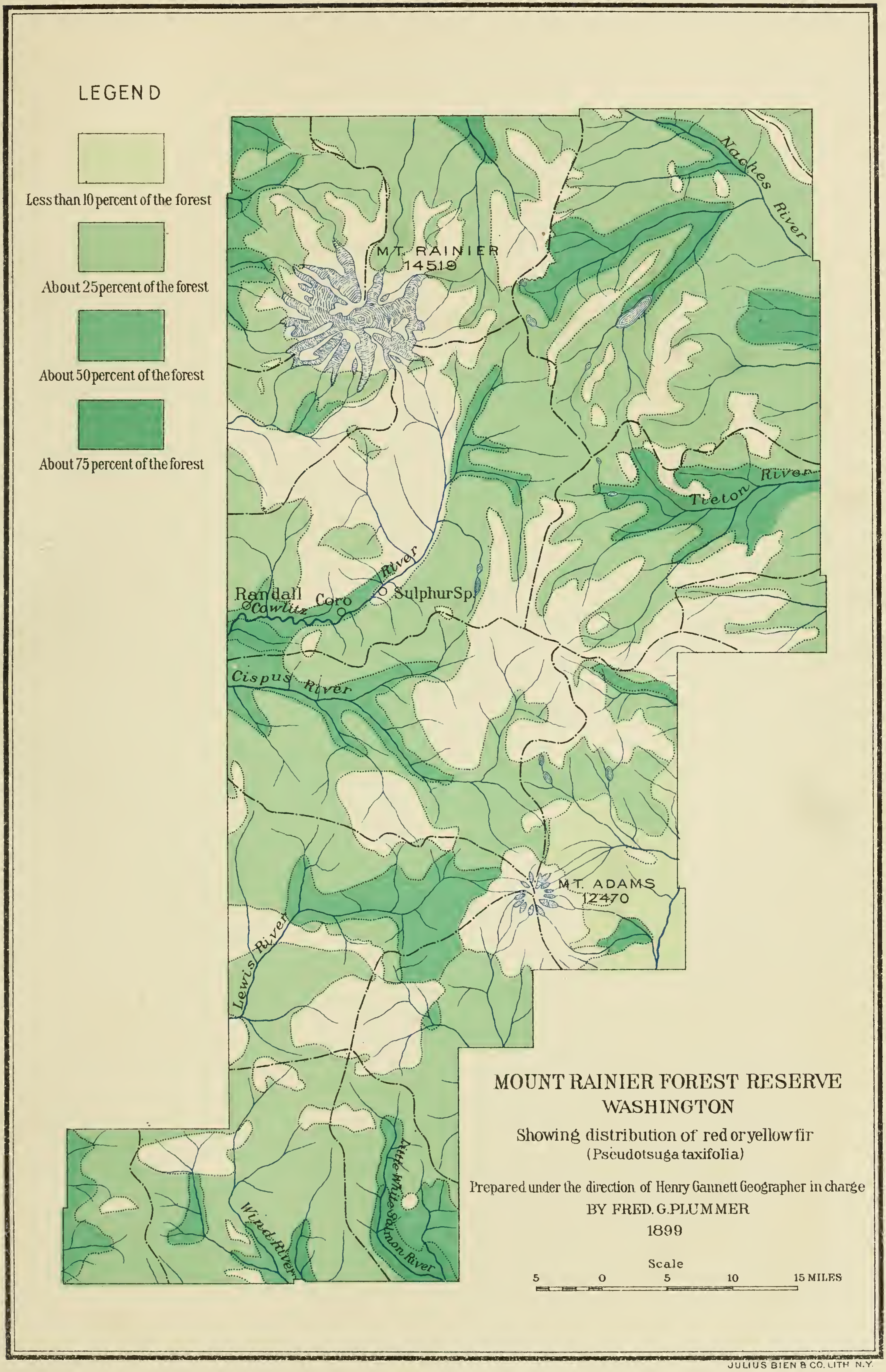
These veins do not show any characteristics of true fissure or contact fissure veins, there being no ribbon structure of the vein matter or striation of the walls, but merely an impregnation of the country rocks, which would indicate that they are merely gash veins which will in all probability terminate at a slight depth.

The placer ground on Moore Creek, at the base of Gold Hill, is said to give colors to every pan, but inasmuch as several parties have operated it in years past and have given it up it can not be very profitable.

The Medina Mining Company is building a 5 stamp mill on the west side of Silver Creek to test the free or oxidized ore. On the opposite side of the gulch the Florence Company is running a crosscut tunnel easterly in diabase rock for the purpose of tapping some ore veins that crop on the slope of the mountain above. If the company is successful in this it may prove that the veins at this point have depth and are not gash veins in the cleavage of the country rock.

MINERAL SPRINGS.

James Longmire patented 20 acres of land lying in secs. 29 and 32, T. 15 N., R. 8 E., as a mineral claim. He erected an inn, barn, two bath houses, one storehouse, and two small shacks.


LEGEND
Less than 10 percent of the forest
About 25 percent of the forest
About 50 percent of the forest
About 75 percent of the forest
MT. RAINIER
14519
Naches River
Tieton River
Randall
Cowlitz
Coro
River
Sulphur Sp.
Cispus River
MT. ADAMS
12470
Lewis River
Wind River
Little White Salmon River
Scale
5 0 5 10 15 MILES

MOUNT RAINIER FOREST RESERVE
WASHINGTON

Showing distribution of red or yellow fir
(Pseudotsuga taxifolia)

Prepared under the direction of Henry Gannett Geographer in charge
BY FRED. G. PLUMMER
1899

JULIUS BIEN & CO. LITH. N.Y.

Within the limits of this claim are about twenty mineral springs having temperatures from 50° to 90° F. A sample of one of the springs was sent to G. A. Mariner, of Chicago, for analysis, who reported as follows:

Analysis of water from secs. 29 and 32, T. 15 N., R. 8 E.

[Analyst: G. A. Mariner.]

	Grams.
Silica	0.080410
Calcium carbonate	1.077200
Magnesium carbonate	.617780
Iron oxide	.060500
Sodium sulphate	.090251
Sodium chloride	1.463600
Potassium chloride	Trace.
Sodium carbonate	.063195
Sodium silicate	.062326
Hydrogen sulphide	Trace.
Total solids in one liter	3.515262

These springs are steady in their flow and have shown no signs of failing.

On the north side of Summit Creek in the Cowlitz watershed is a mineral spring claimed by David Longmire. It was located September 5, 1897, as a red mineral paint spring claim. The spring is 4 feet in diameter and is 100 feet from Summit Creek. The amount of flow is about 1 cubic foot per minute. It tastes like soda water strongly impregnated with iron. The temperature is about 40° and the water is very refreshing. The pack animals drank it with relish.

A similar spring is reported on the right bank of Bumping River, 5 miles below Tannum Lake.

A mineral spring is located on the north side of Cowlitz River in sec. 32, T. 13 N., R. 9 E. The waters issue from several fissures of the rock in place and flow into the river, which is only 10 feet distant. The spring is below the level of high water, and its waters are strongly impregnated with sulphur and iron, and have a temperature of about 100° F.

In sec. 34, T. 14 N., R. 14 E., on the south side of Tieton River, are mineral springs having a flow of about 0.25 cubic foot per minute. One has a temperature of 105° F. The others are cold.

The Klickitat soda springs in the north half of sec. 23, T. 11 N., R. 12 E., are probably the finest soda springs in the reserve, although they have not so great a flow as the Longmire Springs, nor are they as well situated for use. The main spring issues from a rock crevice on the south side of Klickitat River, below the high-water line. To make the water accessible the stock herders have built a wing dam which exposes the bubbling spring. Its flow is about 1 cubic foot per minute, and is steady. The water is clear and sparkling, with an agreeable taste resembling vichy. It is a strong appetizer, and acts quickly and vigorously upon the kidneys.

On the north side of the river, and just above high-water mark, are two barely perceptible springs, one warm and the other cold. Two other springs issue in the bed of the stream, and can be located by the bubbles of gas which rise to the surface.

In sec. 36, T. 9 N., R. 12 E., is a fine soda spring, which has long been known and used by the Indians. Its waters are clear and cold and carry iron, as is shown by the red formation about it. Its flow is 0.25 cubic foot per minute. Near this spring are three yellow pines (*Pinus ponderosa*) of less than 18 inches diameter, which have been affected by the spring. Their foliage is of a light-brown color, is very scanty, and droops.

Numerous small soda and iron springs are found along the Clearwater Fork of the Klickitat River in the box canyons.

EVIDENCES OF RECENT VOLCANIC ACTIVITY.

On the slopes of Mount Adams are many evidences of recent volcanic activity, and important among these are cinder cones and bombs.

The cinder cones are miniature volcanoes in form. One, situated about 3 miles northeast of the summit of Mount Adams, at an elevation of 7,000 feet, is worthy of special mention. Its height is about 500 feet and the crater at its summit has a diameter of 175 feet and a depth of 75 feet. The cinders which form its mass and the flora growing upon it are unique and interesting.

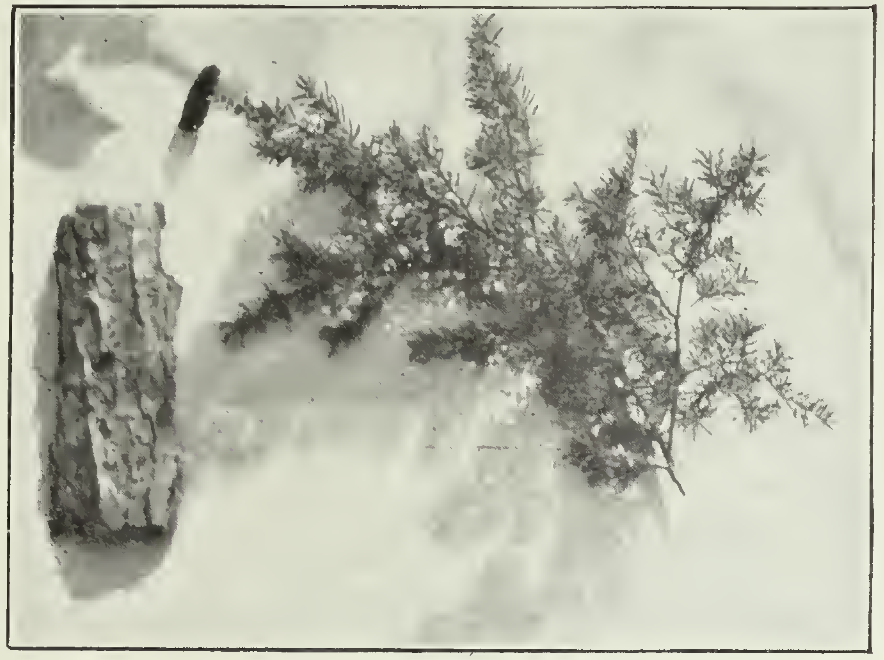
The lava, scoria, and pumice are often of brilliant colors—red, orange, and yellow predominating. Some of the pumice is of finer texture than that in use commercially, and the volcanic glass is found in all shades, from black to clear, transparent globules.

On the northern side of Goat Peak an area of over 1,000 acres is completely covered with scoria and cinders, and this area is timberless. If a crater exists it was covered with snow at the time of the examination.

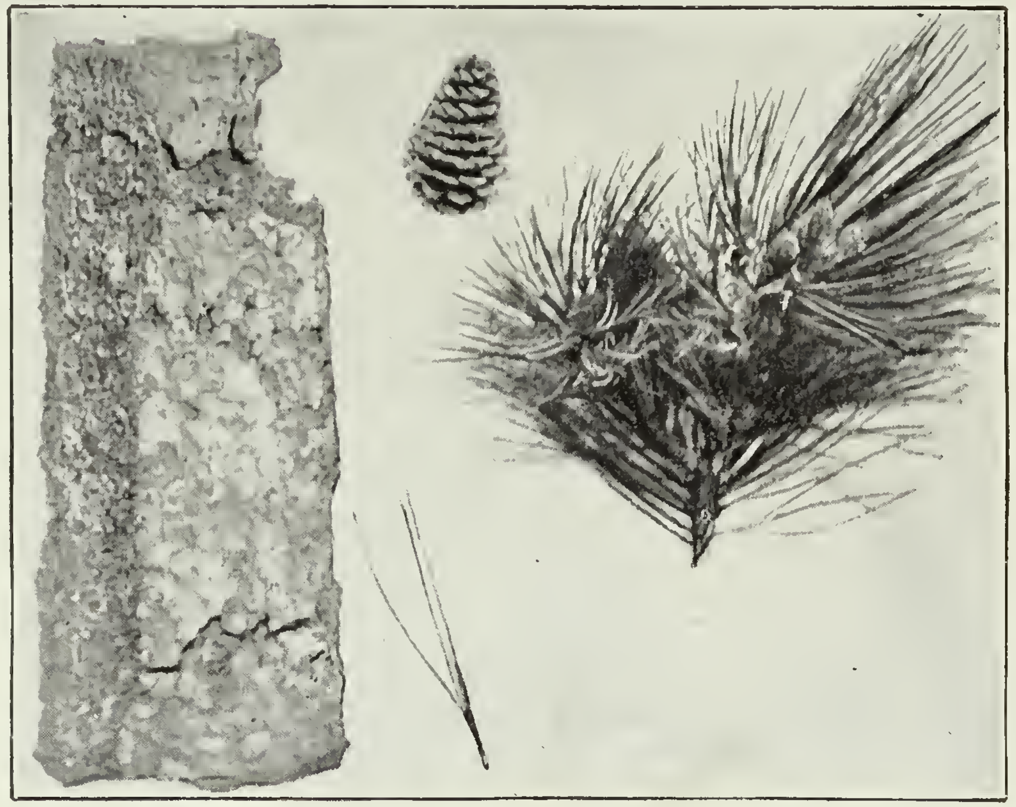
The bombs found on the lower slopes of Mount Adams are spherical masses of homogenous lava, and lie in piles upon the former lava flows. They are of all sizes up to 20 feet in diameter, and in every case have been fractured and their hard, glassy formation exposed. Frequently the fracture planes show a rind of several inches depth from the original spherical surface toward the center.

CAVES.

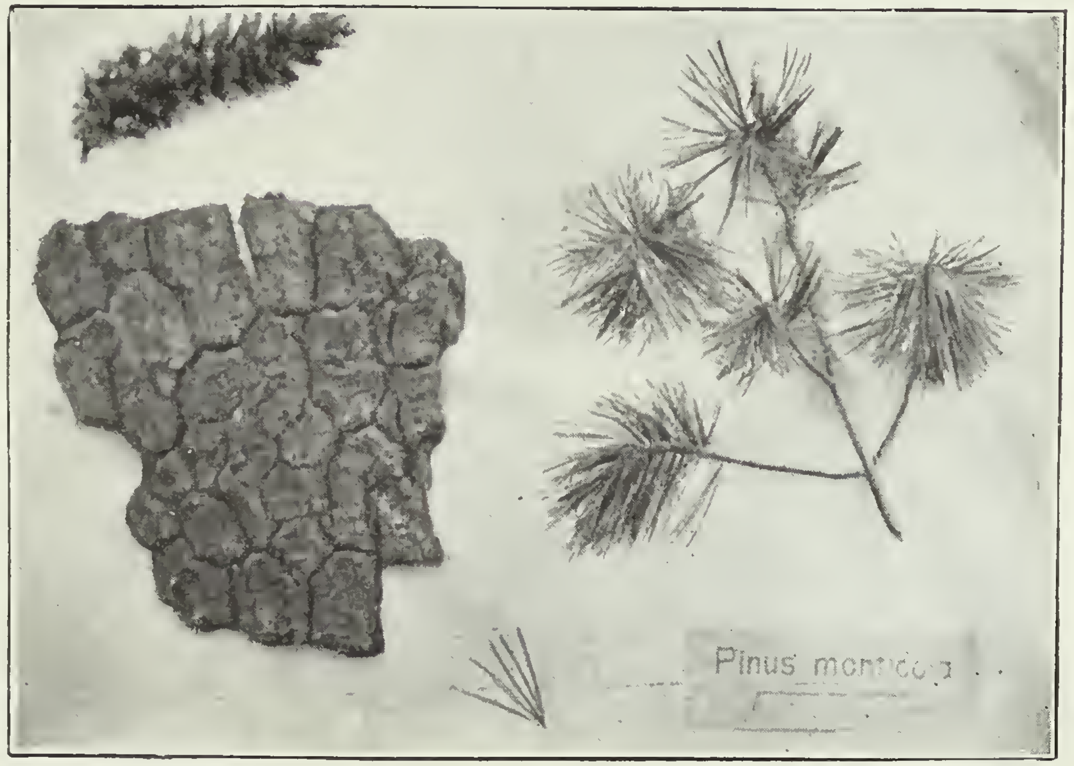
At the headwaters of the White Salmon and Little White Salmon rivers are large areas of partly exposed lava beds. Where a soil has formed it appears to be good, but of no depth, and the timber which it



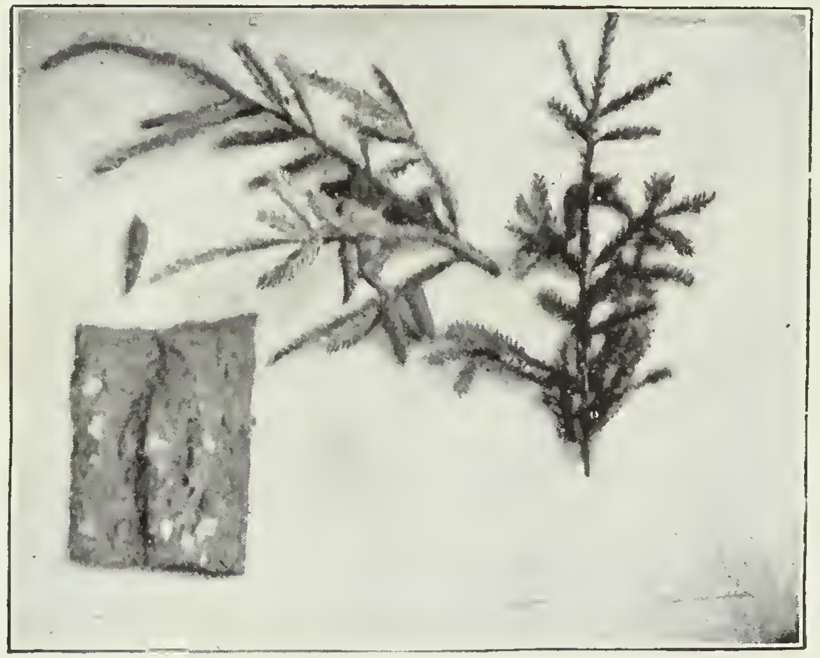
A. TSUGA PATTONIANA.



B. PINUS PONDEROSA.



C. PINUS MONTICOLA.



D. PSEUDOTSUGA TAXIFOLIA.

supports is scrubby and of small size. A line of caves may be traced along this formation for a distance of 10 miles inside of the reserve and as far again outside. In some cases the caverns appear to exist by reason of the sinking of the flooring, which is of basalt, but quite as frequently they take the form of gigantic bubbles, the roof stratum being buckled up and broken, permitting an entrance to the interior.

Often these caverns are continuous for a considerable distance underground, the passages widening in the vicinity of the surface opening. In one of these caves, situated in sec. 25, T. 6 N., R. 9 E., ice remains during the entire year, and it has merited the local name of the "Ice Cave." It is about 350 feet in length, with a maximum height of 10 feet and extreme width of 60 feet.

The ice is in the form of stalactites and stalagmites; in some cases joined into pillars 3 feet thick. It has been a custom of visitors to build fires in the caves, and much of the natural beauty of this cave has been destroyed. The practice of wantonly breaking the ice formations has also contributed to the destruction of its beauty.

A small cave was found on the southeast slope of Mount Adams, near Hell Roaring River. Deep water prevented its exploration.

MOUNTAIN PARKS.

All the divides become beautiful parks as they approach the slopes of Mount Rainier. In place of the close stand of forest which characterizes the lower slopes, the mountain firs and hemlocks are grouped upon the lesser ridges and hummocks from which the snow first disappears in the spring. At least 80 per cent of the areas above 5,000 feet and below the timber line may be classed as mountain meadows. They are plentifully watered by little streams and lakes and the soil supports a heavy growth of wild flowers, ferns, and juniper. The limit of perpetual snow extending through some of these parks gives opportunities for coasting and snowballing, which are enjoyed by the many campers who make these grounds their summer resort. Parks which are well known because of their beauty and accessibility are Paradise Park, Magnetic Park, and Indian Henry's Ground, on the southern slope of the mountain, Spray Park on the northwest slope, Moraine Park and the Elysian Fields on the northern slope.

The summit of the Cascade Mountains and the high spurs that extend from it are generally a succession of parks, plentifully grassed and flowered. On the eastern slope these areas have been considerably used for pasturing sheep, and much of their natural beauty destroyed, but only in the regions of the burns do any of the grander vistas bear witness to the carelessness or greed of man.

TREE SPECIES.

The coniferous trees of the reserve are as follows:

Coniferous trees of Mount Rainier Forest Reserve, Washington.

Pinus monticola Dougl	White pine.
Pinus ponderosa Laws	Yellow pine.
Pinus murrayana Oreg. Com	Lodgepole pine.
Pinus albicaulis Engelm	Mountain pine (white-bark).
Abies nobilis Lindl	Noble fir (larch).
Abies amabilis (Loud.) Forb	Lovely fir (larch).
Abies concolor (Gord.) Parry	White fir.
Abies lasiocarpa (Hook.) Nutt	Alpine fir (subalpina).
Tsuga mertensiana (Bong.) Carr	Hemlock.
Tsuga pattoniana Engelm	Mountain hemlock.
Picea engelmanni (Jeffr.) Engelm	Engelmann spruce.
Picea sitchensis (Bong) T. and M	Tideland spruce.
Pseudotsuga taxifolia Poir	Red and yellow fir (hemlock spruce).
Thuja plicata Don	Red cedar.
Chamæcyparis nootkatensis (Lamb.) Spach.	Alaska cedar.
Larix occidentalis Nutt	Tamarack.
Taxus brevifolia Nutt	Yew.

The large deciduous trees are as follows:

Deciduous trees of the Mount Rainier Forest Reserve, Washington.

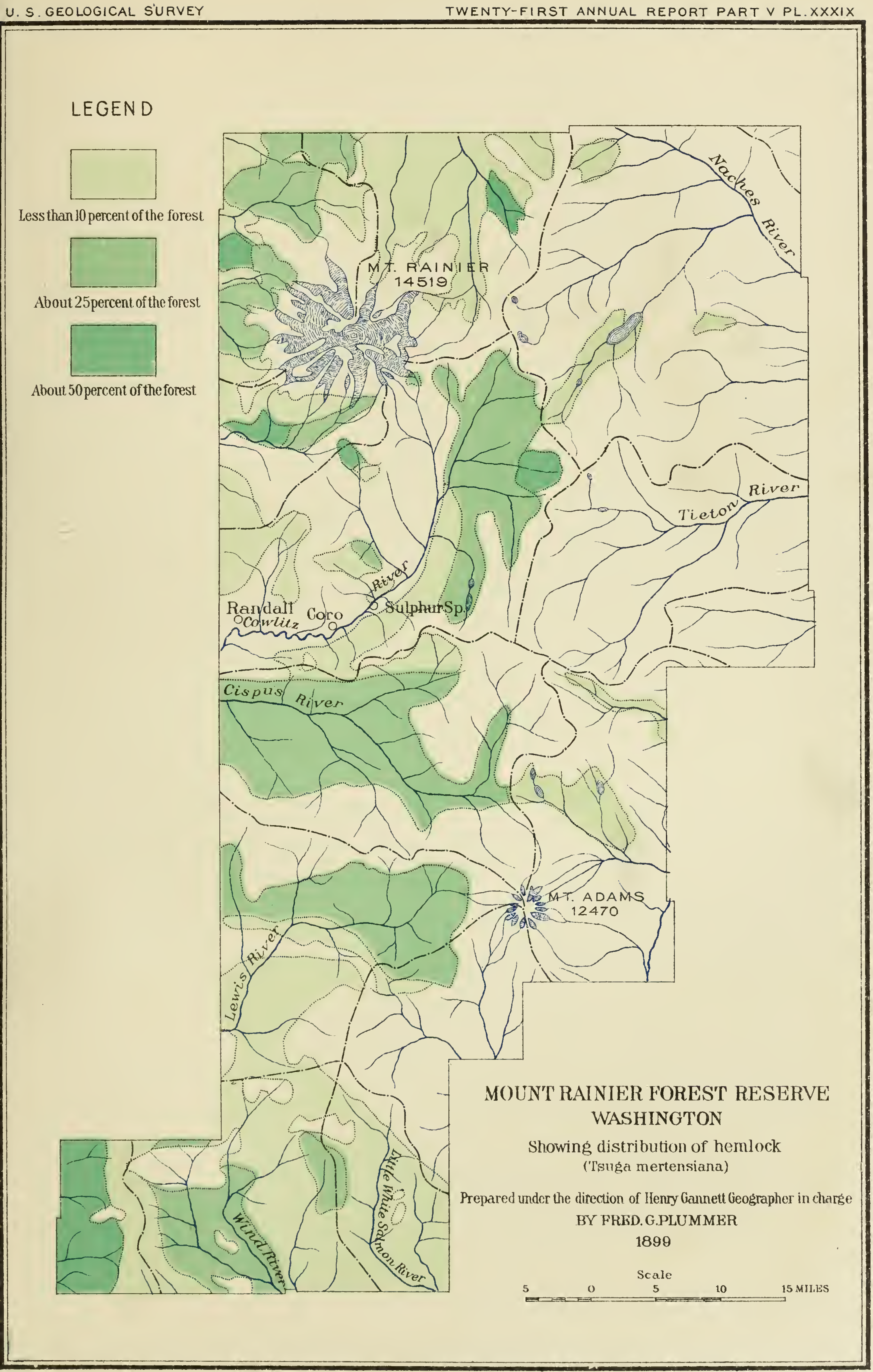
Fraxinus oregona Nutt	Ash.
Acer macrophyllum Pursh	Maple.
Populus trichocarpa Torr. and Gr	Cottonwood.
Populus tremuloides Michx	Quaking aspen.
Quercus garryana Dougl	Oak.

Small deciduous trees of no value as timber are included in the list of underbrush.

In the descriptions which follow, the order of arrangement is the same as given above, the trees of each genus being together without regard to commercial rank.

PINUS MONTICOLA Dougl. (White pine).

This species is found from sea level to an elevation of 6,000 feet. The greatest diameter is 5 feet and the extreme height of individuals observed was 150 feet. About two-thirds of the height is crown. The heartwood is white and the sapwood light yellow. The wood is light, soft, not very strong, but quite durable. It reaches its greatest development at an elevation of 3,500 feet, and in comparison with the other pines occupies a middle zone, being above the yellow pine (*P. ponderosa*) and below the lodgepole and mountain pines (*P. murrayana* and *P. albicaulis*). Although not as strong as the yellow pine, the



MOUNT RAINIER FOREST RESERVE
WASHINGTON

Showing distribution of hemlock
(Tsuga mertensiana)

Prepared under the direction of Henry Gannett Geographer in charge
BY FRED. G. PLUMMER
1899

JULIUS BIEN & CO LITH N Y

absence of pitch and more even texture makes it the most valuable of the pines found in the State of Washington. The typical tree is erect and graceful, with lighter and more delicate foliage than other pines. It is found on both sides of the Cascade Range, but attains its best development on the moist hillsides and benches of the eastern slopes. It does not form a forest of pure growth, being always associated with one or more species of fir or with the red cedar (*Thuja plicata*).

PINUS PONDEROSA Laws. (Yellow pine).

This species has a range of from 400 to 6,200 feet in altitude. The extreme diameter noted was 6 feet, with a height of 200 feet. The heartwood is yellow and the sapwood is white and resinous. The wood is heavier than that of the white pine and stronger, though rather brittle and not very durable when exposed to moisture. Among the pines it occupies the lowest altitudinal zone, reaching its maximum development at an elevation of 2,500 feet, and by reason of its greater accessibility and distribution it is commercially the first in use. The inferior trees are called bull pines, and with many lumbermen a distinction is made, dependent upon the amount of sapwood in the log.

The yellow pine forms an open forest of pure growth at the lower timber line in eastern Washington bordering the arid region, for the reason that it leads the other conifers in the spreading of the timber. Its ability to grow on worthless rocky soil, on the face of cliffs, or on the talus is marvelous. It is a necessary agent to promote the accumulation of soil and humus for the conifers of greater commercial value which follow its lead.

The yellow pine is not strictly an eastern Washington tree, as it occupies many small and scattered areas on the western prairies near Roy, but these areas are insignificant in comparison with its universal occurrence in the lower timbered areas east of the mountains.

At its highest altitudinal limit the yellow pine, although dwarfed in height, attains large diameter of trunk and appears strong and thrifty. The crown is low and the main branches abnormally heavy and without the symmetry of the typical forest tree at lower altitudes.

PINUS MURRAYANA Oreg. Com. (Lodgepole pine).

The extreme range of this species is from 1,800 to 7,100 feet in altitude, but its growth above 5,000 feet is very scattered, and it is only the presence of a few individuals that puts the upper limit at 7,100 feet. It attains a height of 80 feet and a diameter of 26 inches rarely. The heartwood is creamy, white, or pink, and the sapwood slightly whiter. The timber being generally small and of poor quality, it is chiefly used for fence rails and firewood. At an altitude of 4,000 feet it attains its maximum growth, and on some of the dry river benches forms pure forests over small areas. Even at maturity the crown covers three-fourths or seven-eighths of the height. *Pinus contorta*, also called "black pine," has a lower range to sea level, but was not positively determined within the boundaries of the reserve.

PINUS ALBICAULIS Engelm. (Mountain pine).

This species of pine is only found on the higher elevations, and has a range from 5,000 to 8,200 feet. It is the only tree found above 7,500 feet. Its extreme height is 50 feet, with a diameter of 26 inches. According to its exposure, it may be three-fourths crown or with only a very scanty foliage on the lee side near the top. The heartwood and sapwood are light straw color. The wood is hard and tough, and splits with difficulty.

It sets cones in abundance at an altitude of 7,000 feet, where it often comprises 90 per cent of the trees. Its associates at this altitude are *Abies lasiocarpa*, *Tsuga pattoniana*, and *Chamæcyparis nootkatensis*, all of which have reached their growth at lower elevations. The seeds are edible, and the trees are sometimes cut down to secure them. On one ridge of Mount Adams about 100 trees were felled for this purpose.

At and near its higher altitudinal limit it is a mere shrub, finding shelter behind larger rocks or crags. The foliage is often thickly matted, and in its procumbent form hides the gnarled trunk, which is of monstrous size in comparison with its crown.

ABIES NOBILIS Lindl. (Noble fir).

This is the finest timber tree in the forests of the reserve, and is found between altitudes of 1,800 and 5,200 feet. The diameter of the largest individual found was 6 feet, with a height of 225 feet. In the forest the crown extends only one-third of the height, and the trunk is generally a perfect cylinder, standing perpendicular. The heartwood and sapwood are light straw color, light, hard, strong, and elastic, and quite free of resin. The elevation at which it flourishes best is 3,000 feet, but with the lovely fir (*Abies amabilis*) it often forms dense forests at 3,500 and even 4,000 feet.

ABIES AMABILIS (Loud.) Forb. (Lovely fir).

This species is found between altitudes of 800 and 5,500 feet. The trees attain a height of 200 feet, with a diameter of 5 feet, of which one-third to one-half is crown in the forest growth. In the open it often has branches to the ground. The heartwood and sapwood are light straw color, the heartwood being slightly darker. The wood is not hard nor very strong, and splits easily between knots.

A. LARIX OCCIDENTALIS.

B. PICEA ENGELMANNI.

C. ABIES LASIOCARPA.

D. PINUS ALBICAULIS.

The wood of this fir is very little known commercially in Washington, but has been cut and sold with the noble fir under the name of larch. Its wood is better than that of the white fir (*Abies concolor*), with which the tree is sometimes confounded, but will not rank with that of the noble fir. It has been used in the manufacture of excelsior.

Abies concolor (Gord.) Parry (White fir).

This fir has an altitudinal range from sea level to 4,200 feet. The extreme diameter noted was 3.5 feet, with a height of 150 feet, of which two-thirds was crown. The heartwood is white and the sapwood a creamy color. The timber is not heavy, hard, nor strong, but is rather brittle, and perishable when exposed to alternate moisture and dryness. There is a prejudice against the wood, as it compares poorly with the species now being logged for building timber. It has been used for inside finishing, and from the larger trees fine shingles can be made.

Abies lasiocarpa (Hook.) Nutt. (Alpine fir).

This beautiful fir has an altitudinal range from 4,000 to 7,500 feet. The greatest diameter is 2 feet and height 80 feet, of which nine-tenths is crown. Heartwood is a creamy color and the sapwood is white. The wood is not very heavy, hard, nor strong, but is elastic and durable when seasoned. It is almost always associated with Patton's hemlock in the higher altitudes. The typical tree is an acute cone extending almost to the ground in strong and vigorous branches. The base of the cone is about one-fifth of the height. The trunk is generally straight, and, by observation of the young trees, is generally scrubby, knotted, and twisted, and much dwarfed in growth. At the timber limit of 7,500 feet it is procumbent and attains the form of grotesque bushes and shrubs. In the lower valleys where this species is found there is sometimes 30 feet of clear trunk, above which the branches droop in graceful curves. The wood splits straight, but with difficulty between the knots, which run to the center of the tree.

This tree is not known to the local lumbermen, and owing to its small size and lack of clear trunk is of little or no commercial value.

Tsuga mertensiana (Bong.) Carr. (Hemlock).

This tree is found from sea level to an altitude of 5,000 feet. Extreme diameter is 6 feet, with a height of 250 feet, of which one-half to two-thirds is crown. The heartwood is grayish white, and the sapwood is cream color. It is not very heavy, but is hard and quite strong. It is more brittle than fir, although not so durable, and the knots run to the center of the tree.

It sometimes forms a forest of pure growth, but in this case the timber is generally very tall and slender, and only suitable for piles. Although in Washington it ranks next to fir in quantity, it is generally considered an inferior wood, and has been logged very little in this State, except in localities where the fir has become scarce. Time will probably overcome the prejudice to the hemlock timber, as it makes very good floors and ceilings and has a very good surface under the plane. It does not splinter like the eastern hemlock, and takes stain and oil easily. The bark of this hemlock is useful for tanning, and the preparation of tanning extract is an industry at Clallam Bay and South Bend. The bark, being very rich in tannic acid, makes a very superior extract. Owing to the limited market on the Pacific coast and the cost of sending the product East to compete with other extracts in a falling market, incident to the panic of 1893, it was found that it could not be manufactured at a profit at South Bend.

TSUGA PATTONIANA Engelm. (Mountain hemlock).

This hemlock is found from an altitude of 3,500 to 7,500 feet. The largest diameter is 3 feet, and height 125 feet, four-fifths of which is crown. The wood is yellow, hard, and somewhat brittle. It sometimes forms a forest of pure growth over limited areas, but is generally found associated with *A. lasiocarpa* and *P. albicaulis*. The largest and heaviest stands of these hemlocks were found at an elevation of 6,000 feet near Jennies Peak, but the clear trunks were seldom over 40 feet.

PICEA ENGELMANNI Engelm. (Engelmann spruce).

This spruce has an altitudinal range from 1,000 to 6,200 feet. The greatest diameter is 3.5 feet, with a height of 150 feet, of which one-half to two-thirds is crown in the forest trees. Mature trees growing in the open generally have a symmetrical cone-shaped crown to the base. The heartwood and sapwood are white, soft, light, and not very strong. It has even grain and splits easily and, being without pitch or disagreeable odor, is a very valuable wood commercially, particularly for cooperage and fruit boxing.

No forest of pure growth was found. The best growth is upon the lower mountain slopes and benches, where it is associated with pines, firs, and tamarack.

PICEA SITCHENSIS (Bong.) T. and M. (Tide-land spruce).

This species is found from sea level up to an elevation of 1,800 feet within the boundaries of the reserve, west of the Cascade Mountains. It sometimes reaches a diameter of 5 feet and a height of 175 feet, of which two-thirds would be crown. The wood is white, light, medium

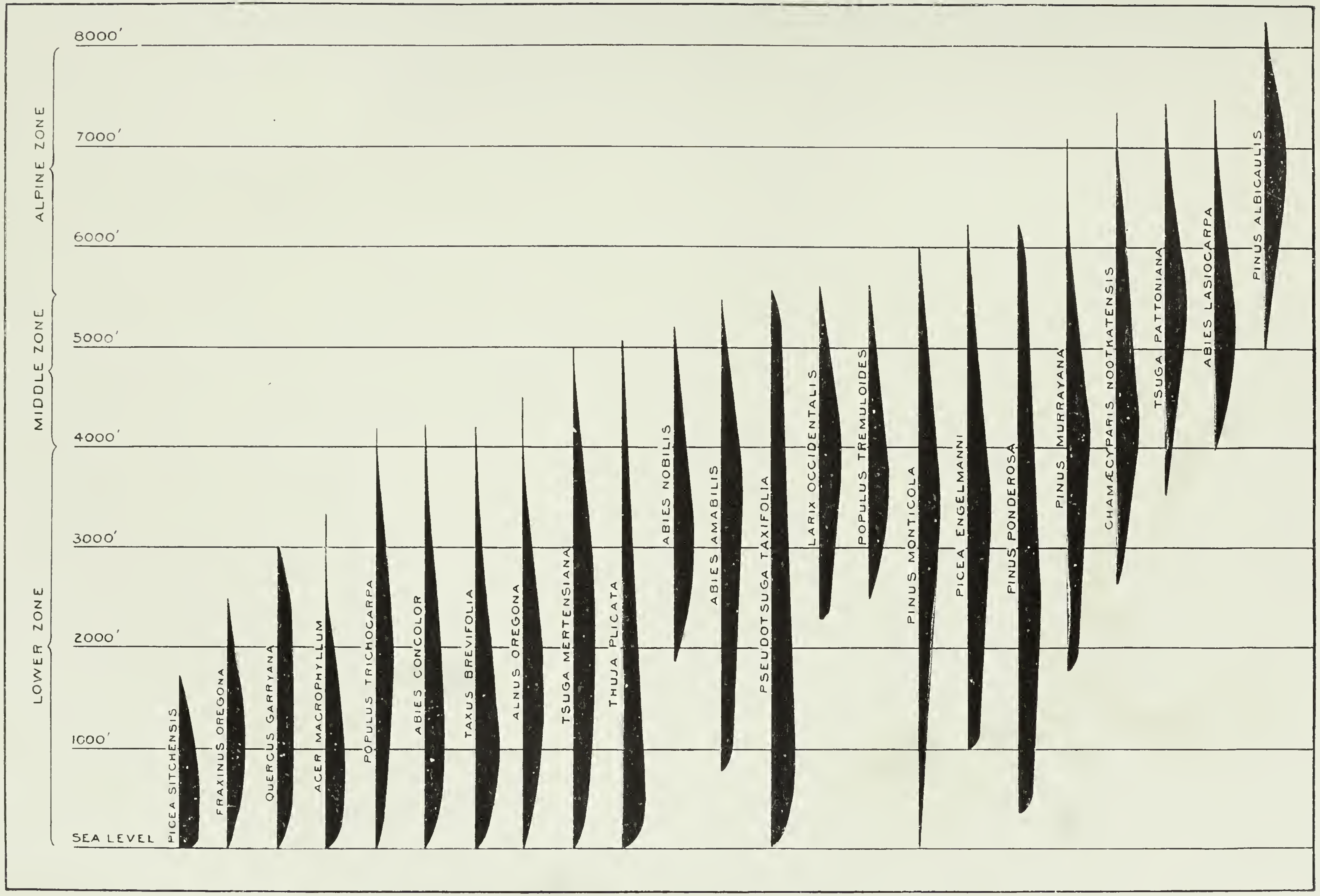


DIAGRAM SHOWING RANGE AND DEVELOPMENT OF TIMBER TREE SPECIES

hard, and strong, and is brittle when green, but quite durable and splits easily. This spruce was positively determined only at one point in the reserve—namely, in the Nisqually Valley, near the west boundary—and it was from this that the upper limit of 1,800 feet was fixed. As its name indicates, its habitat is at lower elevations than those of the reserve.

PSEUDOTSUGA TAXIFOLIA Poir. (Yellow and red fir).

There are two varieties of this species which are not distinct botanically, although the difference is recognized by loggers and mill men throughout the State. The yellow fir grows from sea level to an altitude of 5,600 feet, and reaches an extreme diameter of 13 feet and a height of 300 feet, of which two-thirds is crown. The bark is very thick and deeply fissured. The thickest specimen of bark found measured 22 inches on the radial line. The heartwood is yellow and the sapwood is white, quite heavy, hard, elastic, durable, and splits easily. The red fir, which grows to about the same altitude, does not exceed 7 feet in diameter and 225 feet in height, of which two-thirds is crown. The heartwood is salmon-red color and the sapwood is white or cream color. It is slightly heavier than the yellow fir, more resinous, and not so strong or elastic. When seen in the forest the red fir differs by having a thin bark of a lighter color, and in general does not present as rugged an appearance as the yellow fir. However, many specimens were found which were difficult to determine, and in individual trees it would not be easy to tell the difference between a thin-barked yellow fir and a heavy-barked red fir. Many of the larger trees having a diameter of from 6 to 9 feet are in process of decay, being from 500 to 800 years old. The bark is scaly and loose from the trunk at the butt, and the tops are dead. In estimating the amount of timber per acre a due allowance was made for the above fact. This timber ranks first in commercial value among the timbers of this State by reason of its superior strength, wide distribution, and accessibility.

In the Cowlitz Bottom a fallen fir tree was examined and found to be perfectly sound (excepting 2 inches of the exposed surface), although it had laid upon the ground for seventy-eight years, as testified by the age of a cedar tree which had grown over and straddled it.

THUJA PLICATA Don. (Red cedar).

This tree, which is also known as arbor vitæ, has a range from sea level to 5,100 feet. The extreme diameter breast high was found to be 12 feet with a height of 175 feet, of which three-fifths is crown. The heartwood is very light brown and the sapwood generally white. It is very light, soft, and is not strong nor elastic. It is very durable when exposed to moisture and is generally of straight grain, splitting readily into shingles, shakes, and boards. It ranks next to the red and yellow fir commercially, and to the pioneer settlers in the valley it is the most valuable timber.

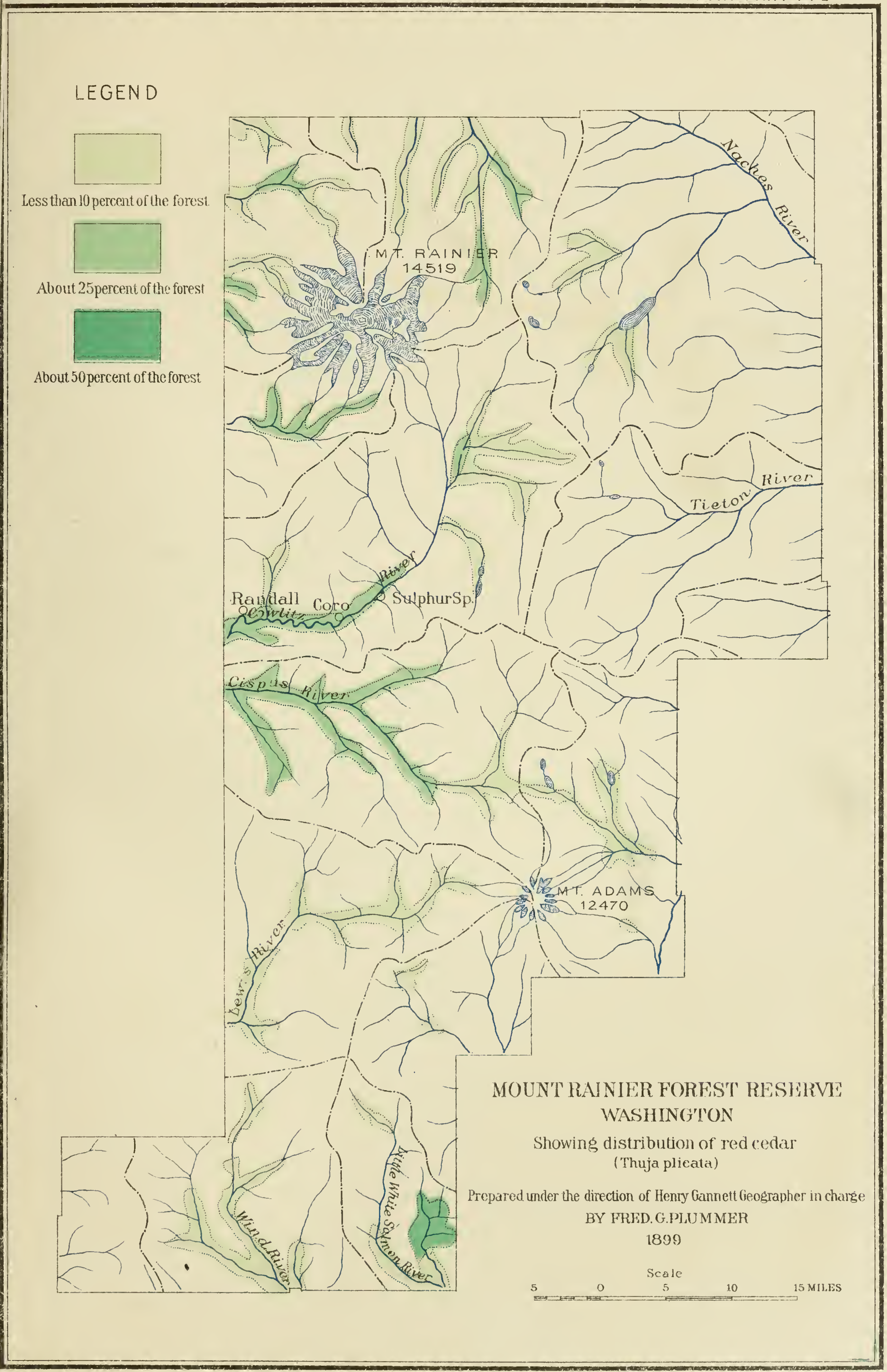
At least 95 per cent of the larger cedars are hollow butted. They always have a swell butt. Of three hollow-butted cedars of 9 feet in diameter the rate of growth, as shown by the shell of sound wood, averaged about ten years per inch radius. In several exceptional cases noted the rate of growth has been very rapid, as much as one-half inch per year for twenty years of successive growth. A fallen cedar tree 36 inches in diameter was observed to be perfectly sound, although another cedar tree 40 inches in diameter had grown over and straddled it. In swamps and swales it sometimes grows to the exclusion of other conifers, but it does not strictly form a forest of pure growth, being accompanied by alders and maples.

CHAMÆCYPARIS NOOTKATENSIS (Lamb.) Spach (Alaska cedar).

This tree is found between elevations of 2,600 and 7,400 feet. The extreme diameter is 3 feet and the height is 100 feet, of which three-fifths is crown. The wood from heart to the bark is yellow. It is light, not very hard nor strong, but is more elastic than the red cedar and very durable, but does not split as easily. Generally the branches look scrubby and give the tree a poor appearance. The outer bark is in long, thin scales and the inner bark strips easily. It never forms a forest of pure growth, but is generally associated with the mountain fir, pine, and hemlock. Generally the areas on which this cedar grows have well-defined limits, but the tree seems to require certain conditions of soil and climate, preferring shady valleys and basins. This timber would be very valuable if more widely distributed and more accessible For turnings and fine woodwork it would excel, as its grain is even and straight, and its color uniform. It would be better material for lead pencils than many varieties of wood now used.

LARIX OCCIDENTALIS Nutt. (Tamarack).

This tree is found between altitudes of 2,200 and 5,600 feet. Extreme diameter is 4½ feet and height 150 feet, of which one-half is crown. The heartwood has an orange tinge and the sapwood is white. It is heavy and hard, not very strong, but is durable and does not split easily. It sometimes forms a forest of pure growth on the sides of the river canyons, and such a forest was found upon the flat divide between the Naches and American rivers. The wood makes good tie timber, and is largely used for fuel in eastern Washington. Probably this is the only timber tree of Washington which is not represented on both sides of the Cascade Mountains. It is strictly an eastern-slope tree, and is the only representative of the deciduous conifers in the reserve.



MOUNT RAINIER FOREST RESERVE
WASHINGTON
Showing distribution of red cedar
(Thuja plicata)
Prepared under the direction of Henry Gannett Geographer in charge
BY FRED. G. PLUMMER
1899

JULIUS BIEN & CO. LITH. N.Y.

TAXUS BREVIFOLIA Nutt. (Yew).

This species of yew is found from sea level to an altitude of 4,200 feet. Generally the diameter of the mature tree is about 12 inches, but a few individuals were found with a diameter of 2 feet and a height of 40 feet, of which three-fifths is crown. The heartwood is a deep red and the sapwood has a narrow zone of cream-colored wood. It is very heavy, hard, and strong. It is exceptionally tough and durable when not exposed to extremes of moisture and dryness, and will not split after being seasoned. Although absolutely sound on the outside, one tree 14 inches in diameter was found to be badly split on concentric lines from the butt to a height of 25 feet.

FRAXINUS OREGONA Nutt. (Ash).

This tree has a range from sea level outside of the reserve to an elevation of 2,500 feet within the reserve. Its diameter is 3 feet and height 80 feet, of which two-thirds is crown. The wood is white, heavy, hard, but not very strong as compared with the eastern ash. It is springy and quite durable when seasoned. It splits easily and is used for firewood by the settlers. The only large quantity was found in the "Big Bottom" of Cowlitz Valley, where it is associated with maples and alders.

ACER MACROPHYLLUM Pursh. (Maple).

This maple is found from sea level to an elevation of 3,300 feet. The extreme diameter is 5 feet with a height of 30 feet, three-fourths to seven-eighths of which is crown. The heartwood is straw color and the sapwood is white. It is not heavy, but is quite hard, although the tree is locally known as the soft maple. The wood is strong. It forms small groves of pure growth in the Cowlitz Bottom, but is generally associated with the ash, yew, and alder.

POPULUS TRICHOCARPA Torr. and Gr. (Cottonwood).

This tree grows from sea level to an elevation of 4,200 feet. The greatest diameter is 5 feet and the height 175 feet, of which two-thirds is crown. The heartwood is of a buff color and the sapwood is white. It is light, and is not hard or strong; in fact, it has no quality to recommend it commercially as a timber wood, but has been extensively used in the manufacture of paper pulp.

POPULUS TREMULOIDES Michx. (Quaking aspen).

This tree is found in the wet swales and bottoms, and has an altitudinal range from 2,500 to 5,800 feet. It does not exceed 20 inches in diameter, with a height of 60 feet, of which one-half is crown. The wood is white and soft and of little or no value commercially. All of the large trees examined were rotten at the butt, although they looked clean and healthy outside.

QUERCUS GARRYANA Dougl. (Oak).

This oak is the only one of its species found in the reserve, and, unless the ash and yew be included, it is the only hardwood tree represented. Generally the trees are small, with short trunks, and offer nothing to the lumbermen, but a few individuals were noted with diameters of 2 feet and a height of 50 feet. They are seen at their best on the eastern slope in the watershed of the Klickitat River near Hell Roaring Canyon. This oak is considered first-class fuel, and has been cut extensively along the Columbia River (outside the reserve) for this purpose.

RANGE OF TREE SPECIES.

The accompanying diagram (Pl. XLI) shows in a graphic way the altitudinal range of the species of timber trees found in the reserve. The datum is given as sea level, and those species which extend outside the reserve to tide water are so shown upon the diagram.

The lines showing each species have been widened into forms which are intended to show by their width the relative development of the species. This diagram was compiled from observations taken at 521 locations, ranging in altitude from 700 to 8,200 feet.

The name of each species is placed in the zone to which the tree belongs.

RATE OF GROWTH OF TIMBER TREES.

The average rate of growth of all the conifers, as determined by measuring over 8,000 annual rings, is 0.0741 of an inch per year.

In the table which follows the number of annual rings is given for each 3 inches of radius, and therefore show an increase or decrease in the rate of growth. For example, *Pinus murrayana*, according to the table, shows an increase in the number of rings for each 3 inches of radius. Therefore the rings are closer together near the bark than at the heart, and the rate of growth decreases with age.

When the diameter of a tree was over 36 inches, the measurements are continued in regular order on the lines below, as in the case of *Pseudotsuga taxifolia.*

Table showing rate of growth of timber trees.

Name of tree.	Diameter of wood.	Thickness of bark.	Total diameter.	Number of rings counted on radius from the center.						Age of tree.
				1-3 inches.	4-6 inches.	7-9 inches.	10-12 inches.	13-15 inches.	16-18 inches.	
	In.	*In.*	*In.*							*Years*
Pinus monticola	7	¼	7½	36	11	----	----	----	----	47
Do	22	¾	23½	15	13	17	12	----	----	57
Do	16	½	17	19	19	17	----	----	----	55
Pinus ponderosa	25	2	29	29	36	43	39	7	----	154
Do	31½	2½	36½	27	33	28	38	52	15	193
Do	22	2	26	41	41	61	59	----	----	202
Pinus murrayana	19	¼	19½	34	38	82	39	----	----	193
Do	14	¼	14¼	45	50	62	----	----	----	157
Do	19	¼	19½	26	31	45	5	----	----	107
Do	18	¼	18½	18	28	54	----	----	----	100
Pinus albicaulis	9	¼	9½	130	55	----	----	----	----	185
Do	13	½	14	133	99	35	----	----	----	267
Do	14	½	15	85	115	45	----	----	----	245
Do	20½	¼	21	42	44	59	46	----	----	191
Do	9½	½	10	48	33	----	----	----	----	81
Abies nobilis	22	⅜	22¾	27	15	14	9	----	----	65
Do	17	¼	17½	37	18	12	----	----	----	67
Do	31	1	33	56	36	28	24	24	6	174
Abies amabilis	20	¼	20½	16	20	13	6	----	----	55
Do	12	½	13	71	25	----	----	----	----	96
Do	11	⅜	11¾	68	73	----	----	----	----	141
Do	20	⅜	20¾	132	88	55	13	----	----	288
Do	10	¼	10½	40	28	----	----	----	----	68
Do	15½	¼	16	71	51	50	----	----	----	172
Abies concolor	20	1	22	40	60	96	38	----	----	234
Do	12	¾	13½	74	105	----	----	----	----	179
Do	20	¾	21½	52	37	53	27	----	----	169
Do	17	1	19	64	67	83	----	----	----	214
Do	11	⅜	11¾	119	98	----	----	----	----	217
Abies lasiocarpa	14	¾	15½	60	50	10	----	----	----	120
Do	15	¾	16½	60	48	17	----	----	----	125
Do	10	½	11	40	41	----	----	----	----	81
Do	19	½	20	38	43	70	----	----	----	151
Do	10	¼	10½	34	14	----	----	----	----	48
Tsuga mertensiana	31	1	33	64	70	65	63	84	12	358
Do	29	¾	30½	30	24	25	36	41	----	156

Table showing rate of growth of timber trees—Continued.

Name of tree.	Diameter of wood.	Thickness of bark.	Total diameter.	Number of rings counted on radius from the center.						Age of tree.
				1–3 inches.	4–6 inches.	7–9 inches.	10–12 inches.	13–15 inches.	16–18 inches.	
	In.	*In.*	*In.*							*Years.*
Tsuga pattoniana	14½	1½	17½	54	62	60	....	....	....	176
Do	13	1¼	15½	58	78	12	....	....	....	148
Picea engelmanni	13½	¼	14	65	23	4	....	....	....	92
Do	29	¾	30½	30	16	16	20	24	....	106
Do	20	1	22	30	40	43	28	....	....	141
Pseudotsuga taxifolia	72	6	84	39	40	40	41	41	41	......
Do	....	....	....	40	40	41	41	40	40	484
Do	120	18	156	9	11	16	14	15	25	......
Do	....	....	....	31	19	18	21	18	15	......
Do	....	....	....	18	15	20	21	25	28	......
Do	....	....	....	32	37	....	....	....	....	408
Do	30	¾	31½	38	32	12	9	17	....	108
Do	30	¾	31½	73	14	10	11	10	....	118
Do	40	4	48	15	15	22	35	46	68	......
Do	....	....	....	41	....	....	....	....	....	242
Do	38	3	44	11	18	30	38	46	56	......
Do	....	....	....	19	....	....	....	....	....	216
Do	38	2½	43	17	47	34	50	64	110	......
Do	....	....	....	40	....	....	....	....	....	362
Do	31	2	35	58	54	62	88	98	28	388
Thuja plicata	52	1	54	48	18	16	14	13	17	......
Do	....	....	....	20	22	14	....	....	....	182
Do	34	¼	34½	26	27	10	10	14	10	97
Do	40	¼	40½	27	21	21	6	8	15	......
Do	....	....	....	15	....	....	....	....	....	113
Do	18	1	20	25	35	42	46	56	50	254
Chamæcyparis nootkatensis	19½	¼	20	78	74	97	23	....	....	272
Do	19	¼	19½	48	60	112	10	....	....	230
Do	28½	½	29½	(*a*)	....	....	....	....	....	380?
Do	22	½	23	60	74	90	59	....	....	283
Larix occidentalis	19	2	23	15	14	32	9	....	....	70
Fraxinus oregona	24	¾	25½	25	25	42	50	....	....	142
Do	26½	¾	28	25	25	29	44	25	....	148
Do	5	¼	5½	34	....	....	....	....	....	34
Do	10½	⅜	11¼	38	23	....	....	....	....	61

a Rings too close to count accurately.

Table showing rate of growth of timber trees—Continued.

Name of tree.	Diameter of wood.	Thickness of bark.	Total diameter.	Number of rings counted on radius from the center.						Age of tree.
				1–3 inches.	4–6 inches.	7–9 inches.	10–12 inches.	13–15 inches.	16–18 inches.	
	In.	*In.*	*In.*							*Years.*
Acer macrophyllum	11	½	12	68	35	....	....	....	....	103
Do	28	1	30	48	23	26	38	23	....	158
Do	6	¼	6½	62	.....	....	....	....	....	62
Populus trichocarpa	8	½	9	33	10	....	....	....	....	43
Do	23	1¼	25½	20	21	17	26	....	....	84
Populus tremuloides	14	½	15	24	21	8	....	....	....	53
Do	18	¾	19½	30	26	30	....	....	....	86
Taxus brevifolia	4	⅛	4¼	53	.....	....	....	....	....	53
Do	5	⅛	5¼	68	.....	....	....	....	....	68
Do	16	⅛	16¼	63	53	63	....	....	....	179
Do	10	⅛	10¼	77	81	....	....	....	....	158
Alnus oregona	9½	¼	10	36	23	....	....	....	....	59
Pyrus rivularis	4	⅛	4¼	48	.....	....	....	....	....	48
Rhamnus purshiana	6	⅛	6¼	60	.....	....	....	....	....	60
Do	5½	⅛	5¾	44	.....	....	....	....	....	44
Acer circinatum	4	⅛	4¼	50	.....	....	....	....	....	50
Do	7	⅛	7¼	41	7	....	....	....	....	48
Salix lasiandra	4	¼	4½	18	.....	....	....	....	....	18
Cornus nuttallii	4	⅛	4¼	32	.....	....	....	....	....	32

DEFECTS AND DISEASES OF TIMBER TREES.

About 5 per cent of the forest stand within the reserve is composed of dead snags scattered through the green and live growth. This condition is common to all forests, as it results from the fact that trees die. The cause, however, is not only that of final maturity, for the great majority of these standing snags were young or middle-aged trees, many of which died from lack of light and air—killed by their more vigorous neighbors.

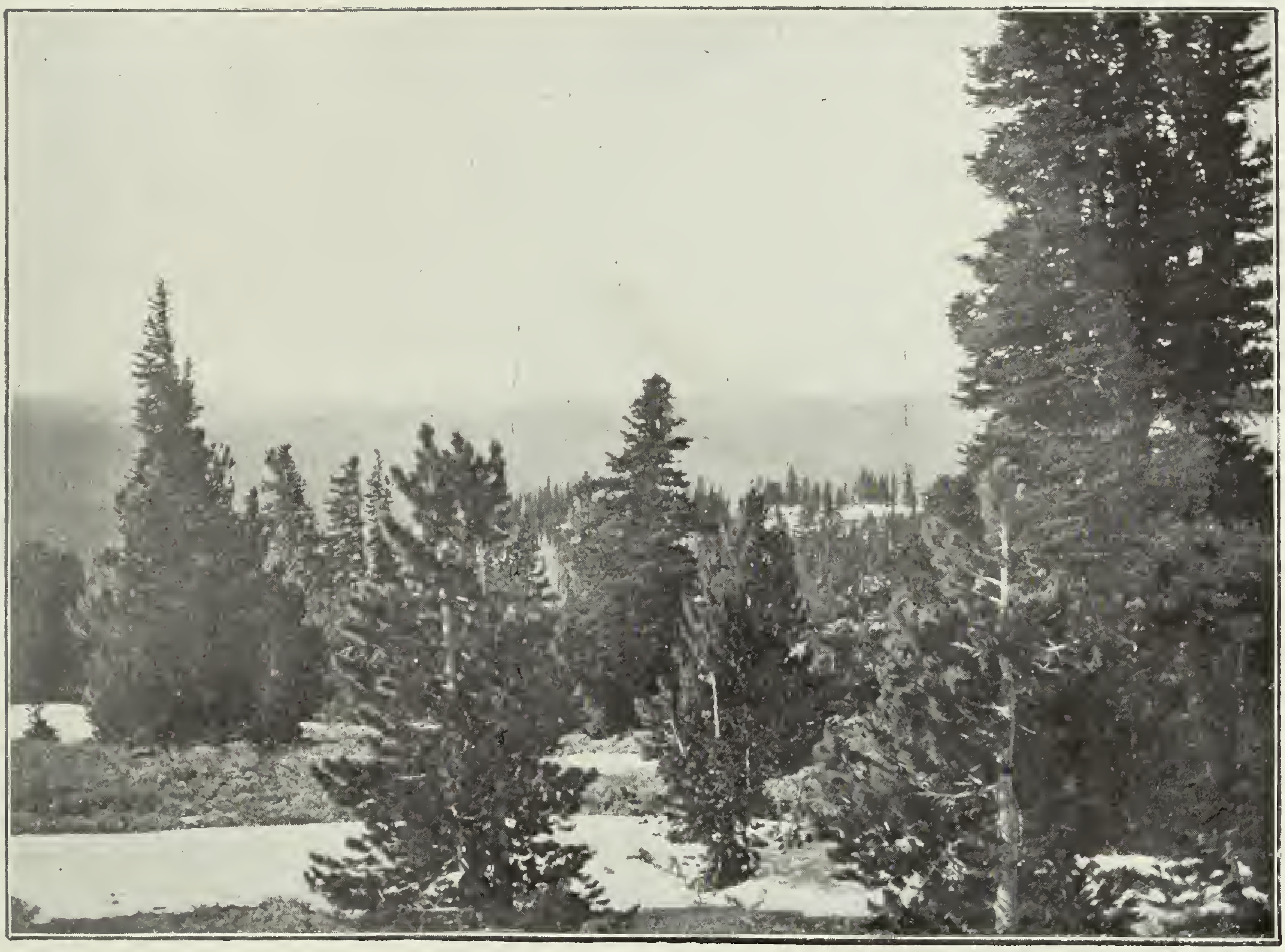
Individual cases were noted where camp fires had run up and killed single trees, also where lightning had struck and killed trees without the fire spreading. Not uncommonly a heavy fall of snow will break the upper branches of a tree, and these falling will strip the trunk of all foliage—a setback that only a vigorous and well-situated conifer can survive.

In those areas where the soil is excessively moist, a common defect is the hollow butt or ground rot. In such places the root hold is not good, and the conifers, lacking the taproot, compensate by developing an enormous growth of roots on a plane conforming with the surface of the ground, thus increasing the base area upon which they stand. Such trees have the "swell butts," and it is not unusual to see a tree of which a section made at the surface of the ground would have from five to ten times the area of a parallel section made 15 feet above it. In these swell butts there is no straight-grain lumber and the wood is coarse, resulting from the rapid growth, which in the case of the red cedar (*Thuja plicata*) amounts to as much as one-half inch annually.

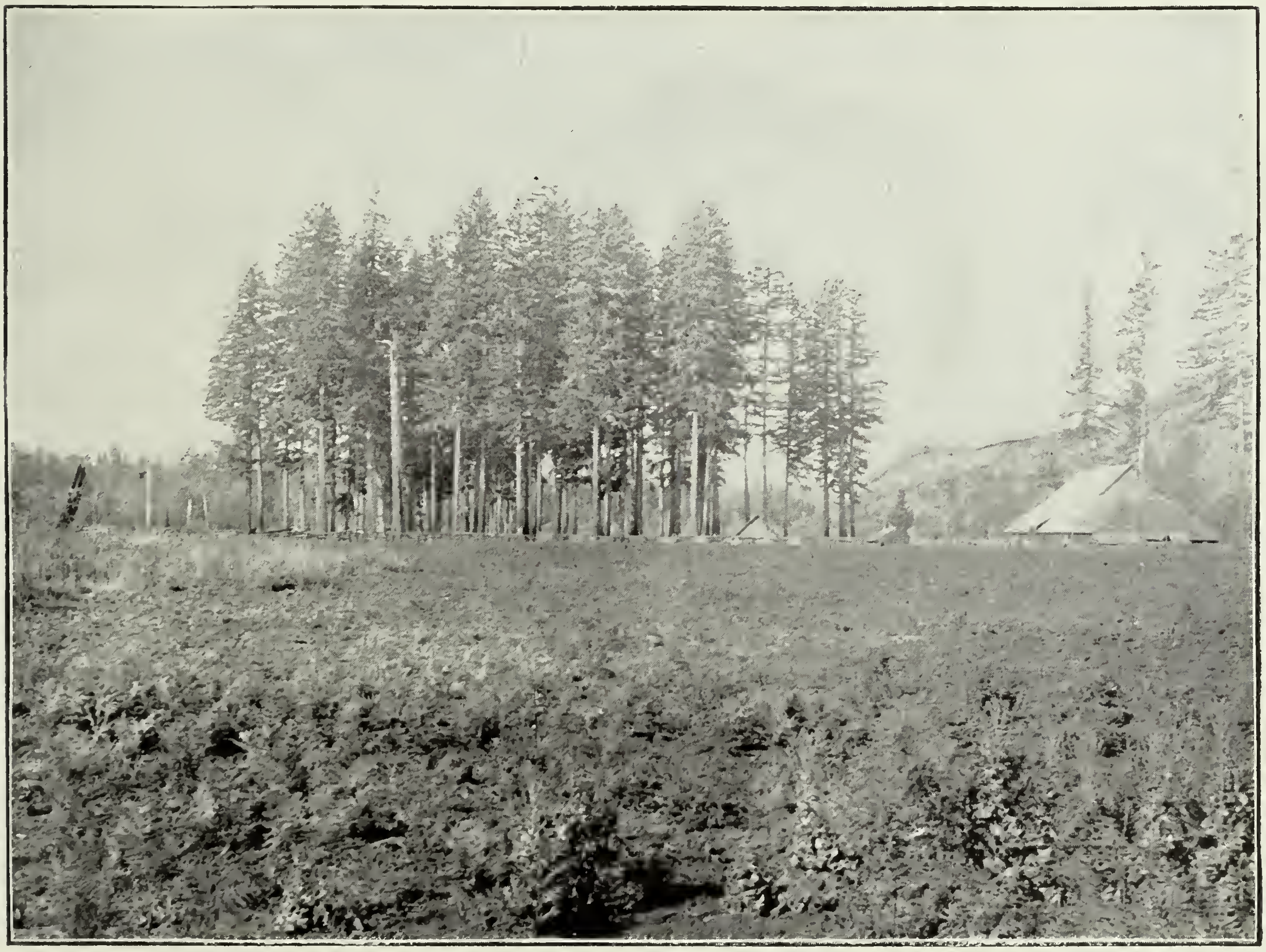
In logging, it is customary to cut the trees above the swell butts, leaving on the stump that portion of the trunk with the decayed center, and in the case of the firs to reject the sappy base of the tree. Cedars with decayed butts generally show dead tops, but this is of minor interest to the lumberman, who seldom cuts logs far into the crown.

In the ideal forest of the lumberman the trees have clear trunks to 100 or 125 feet of height and the crowns form a continuous cover as seen either from below or above. Seldom is the seedling in such a forest able to compete under such conditions, for the existence of such a forest means the elimination of perhaps a hundred seedlings before supremacy in the sapling stage had been established, and the final elimination of at least 90 per cent of the saplings before each successful tree grows skyward in the final competition for light. In areas where this severe competition does not obtain, the tree trunks are "limby," and even when the trunks appear clear at first glance the logs contain "pin knots," which, running through the heartwood, render the lumber second or third class. Large trees standing in the open, where the winds have greater effect, generally throw very few limbs toward the prevailing winds, but compensate on the protected side. The growth of the trunk is then eccentric to the heart and the lumber is not even grained. In the higher and more exposed areas the trees are often without limbs on the storm side, generally the southwest side, and the trees are stunted, as described elsewhere in this report.

It can not be said that the giant shelf fungus (*Polyporus* sp.) is a factor in killing or even in hastening the death of the large dead timber upon which it is found. Of the many hundreds of these fungi that were observed, not one was found upon a living tree. The arceuthobium, on the contrary, attacks the living trees, and its range of activity appears not to be limited by altitude. It is a parasite on the foliage of the pines, firs, and hemlocks of eastern Washington, and in some cases, particularly on the mountain fir (*Abies lasiocarpa*), will cover the entire tree and, turning the foliage a red color, makes the tree a conspicuous object.



A. PINES AND RED FIR.



B. RED FIR IN COWLITZ BOTTOM

ESTIMATES OF TIMBER.

WHITE RIVER WATERSHED.

Density of timber in White River watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2,000	33,570	33,570,000
2,000 to 5,000	18,600	65,100,000
5,000 to 10,000	16,450	123,375,000
10,000 to 25,000	29,150	510,125,000
25,000 to 50,000	16,000	600,000,000
50,000 to 100,000	20,850	1,563,750,000
Total	134,620	2,895,920,000

Average stand per acre for entire watershed, 18,544 feet B. M.

Area of timbered and other lands in White River watershed, Washington.

	Acres.
Timbered area	134,620
Burned area	10,200
Glaciers	8,900
Timberless area	2,440
Total	156,160

Proportions and amounts of timber species in White River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Red or yellow fir	45	1,303,164,000
Hemlock	25	723,980,000
Red cedar	15	434,388,000
Engelmann spruce	5	144,796,000
White pine	3	86,877,600
Alaska cedar	2	57,918,400
White fir	5	144,796,000
Lovely fir		
Noble fir		
Mountain fir		
Mountain hemlock		
Total	100	2,895,920,000

PUYALLUP RIVER WATERSHED.

Density of timber in Puyallup River watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2,000	30,160	30,160,000
2,000 to 5,000	26,770	93,695,000
5,000 to 10,000	11,150	83,625,000
10,000 to 25,000	8,500	148,750,000
25,000 to 50,000	10,900	408,750,000
50,000 to 100,000	12,470	935,250,000
Total	99,950	1,700,230,000

Average stand per acre for entire watershed, 14,428 feet B. M.

Area of timbered and other lands in Puyallup watershed, Washington.

	Acres.
Timbered area	99,950
Burned area	2,580
Glaciers	12,600
Timberless area	2,710
Total	117,840

Proportions and amounts of timber species in Puyallup River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Red or yellow fir	50	850,115,000
Hemlock	25	425,057,500
Red cedar	10	170,023,000
Noble fir	5	85,011,500
White fir	3	51,006,900
Alaska cedar	2	34,004,600
Lovely fir Engelmann spruce Mountain fir Mountain hemlock White pine	5	85,011,500
Total	100	1,700,230,000

NISQUALLY RIVER WATERSHED.

Density of timber in Nisqually River watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2,000	16,610	16,610,000
2,000 to 5,000	3,360	11,760,000
5,000 to 10,000	6,770	50,775,000
10,000 to 25,000	5,960	104,300,000
25,000 to 50,000	6,370	238,875,000
50,000 to 100,000	....	....
Total	39,070	422,320,000

Average stand per acre for entire watershed, 5,414 feet B. M.

Area of timbered and other lands in Nisqually River watershed, Washington.

	Acres.
Timbered area	39,070
Burned area	27,810
Glaciers	8,100
Timberless area	3,020
Total	78,000

Proportions and amounts of timber species in Nisqually River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Red or yellow fir	50	211,160,000
Hemlock	25	105,580,000
Red cedar	10	42,232,000
White fir	5	21,116,000
Noble fir	4	16,892,800
Alaska cedar	1	4,223,200
Lovely fir	5	21,116,000
Engelmann spruce		
Mountain fir		
Mountain hemlock		
White pine		
Total	100	422,320,000

COWLITZ RIVER WATERSHED.

Density of timber in Cowlitz River watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2,000	37,850	37,850,000
2,000 to 5,000	96,380	337,330,000
5,000 to 10,000	12,540	94,050,000
10,000 to 25,000	47,610	833,175,000
25,000 to 50,000	3,720	139,500,000
50,000 to 100,000	2,560	192,000,000
Total	200,660	1,633,905,000

Average stand per acre for entire watershed, 5,611 feet B. M.

Area of timbered and other lands in Cowlitz River watershed, Washington.

	Acres.
Timbered area	200,660
Burned area	86,900
Glaciers	2,900
Timberless area	740
Total	291,200

Proportions and amounts of timber species in Cowlitz River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Red or yellow fir	55	898,647,750
Hemlock	25	408,476,250
Red cedar	5	81,695,250
White fir	5	81,695,250
Noble fir	4	65,356,200
Alaska cedar	1	16,339,050
Lovely fir Mountain fir Mountain hemlock White pine Engelmann spruce	5	81,695,250
Total	100	1,633,905,000

CISPUS RIVER WATERSHED.

Density of timber in Cispus River watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2,000	27,400	27,400,000
2,000 to 5,000	64,200	224,700,000
5,000 to 10,000	24,300	182,250,000
10,000 to 25,000	76,800	1,344,000,000
25,000 to 50,000	----------	----------
50,000 to 100,000	----------	----------
Total	192,700	1,778,350,000

Average stand per acre for entire watershed, 7,535 feet B. M.

Area of timbered and other lands in Cispus River watershed, Washington.

	Acres.
Timbered area	192,700
Burned area	43,000
Glaciers	100
Timberless area	200
Total	236,000

Proportions and amounts of timber species in Cispus River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Red or yellow fir	45	800,257,500
Hemlock	30	533,505,000
Red cedar	10	177,835,000
Noble fir	5	88,917,500
White fir	5	88,917,500
Lovely fir Mountain fir Mountain hemlock White pine Alaska cedar	5	88,917,500
Total	100	1,778,350,000

LEWIS RIVER WATERSHED.

Density of timber in Lewis River watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2,000	14,730	14,730,000
2,000 to 5,000	48,450	169,575,000
5,000 to 10,000	61,810	463,575,000
10,000 to 25,000	7,900	138,250,000
25,000 to 50,000	54,730	2,052,375,000
50,000 to 100,000	1,620	121,500,000
Total	189,240	2,960,005,000

Average stand per acre for entire watershed, 13,295 feet B. M.

Area of timbered and other lands in Lewis River watershed, Washington.

	Acres.
Timbered area	189,240
Burned area	32,360
Glaciers	350
Timberless area	690
Total	222,640

Proportions and amounts of timber species in Lewis River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Red or yellow fir	50	1,480,002,500
Hemlock	20	592,001,000
Noble fir	15	444,000,750
Red cedar	5	148,000,250
Lovely fir	5	148,000,250
White fir	5	148,000,250
Mountain fir		
Mountain hemlock		
White pine		
Total	100	2,960,005,000

WASHOUGAL RIVER WATERSHED.

Density of timber in Washougal River watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2,000	------------	------------
2,000 to 5,000	------------	------------
5,000 to 10,000	2,370	17,775,000
10,000 to 25,000	------------	------------
25,000 to 50,000	------------	------------
50,000 to 100,000	910	68,250,000
Total	3,280	86,025,000

Average stand per acre for entire watershed, 26,227 feet B. M.
Area of watershed, all timbered, 3,280 acres.

Proportions and amounts of timber species in Washougal River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Red or yellow fir	30	25,807,500
Noble fir	25	21,506,250
Lovely fir	25	21,506,250
Hemlock	15	12,903,750
Red cedar White fir White pine	5	4,301,250
Total	100	86,025,000

ROCK CREEK WATERSHED.

Density of timber in Rock Creek watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2,000	------------	------------
2,000 to 5,000	------------	------------
5,000 to 10,000	690	5,175,000
10,000 to 25,000	------------	------------
25,000 to 50,000	690	25,875,000
50,000 to 100,000	4,660	349,500,000
Total	6,040	380,550,000

Average stand per acre for entire watershed, 63,005 feet B. M.
Area of watershed, all timbered, 6,040 acres.

Proportions and amounts of timber species in Rock Creek watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Red or yellow fir	30	114, 165, 000
Noble fir	25	95, 137, 500
Lovely fir	25	95, 137, 500
Hemlock	15	57, 082, 500
Red cedar White fir White pine	5	19, 027, 500
Total	100	380, 550, 000

WIND RIVER WATERSHED.

Density of timber in Wind River watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2, 000	21, 810	21, 810, 000
2, 000 to 5, 000	7, 970	27, 895, 000
5, 000 to 10, 000	3, 220	24, 150, 000
10, 000 to 25, 000	17, 700	309, 750, 000
25, 000 to 50, 000	52, 900	1, 983, 750, 000
50, 000 to 100, 000	18, 430	1, 382, 250, 000
Total	122, 030	3, 749, 605, 000

Average stand per acre for entire watershed, 25,858 feet B. M.

Area of timber and other lands in the Wind River watershed, Washington.

	Acres.
Timbered area	122, 030
Burned area	22, 970
Total	145, 000

Proportions and amounts of timber species in Wind River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Red or yellow fir	45	1,687,322,250
Hemlock	15	562,440,750
Noble fir	10	374,960,500
Lovely fir	10	374,960,500
White fir	5	187,480,250
Red cedar	5	187,480,250
White pine	5	187,480,250
Lodgepole pine Mountain fir Mountain hemlock Engelmann spruce	5	187,480,250
Total	100	3,749,605,000

LITTLE WHITE SALMON RIVER WATERSHED.

Density of timber in Little White Salmon River watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2,000	16,080	16,080,000
2,000 to 5,000	39,590	138,565,000
5,000 to 10,000	4,720	35,400,000
10,000 to 25,000	6,430	112,525,000
25,000 to 50,000		
50,000 to 100,000		
Total	66,820	302,570,000

Average stand per acre for entire watershed, 4,223 feet B. M.

Area of timbered and other lands in Little White Salmon River watershed, Washington.

	Acres.
Timbered area	66,820
Burned area	4,830
Total	71,650

Proportions and amounts of timber species in Little White Salmon River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Red or yellow fir	55	166, 413, 500
Hemlock	10	30, 257, 000
Red cedar	10	30, 257, 000
White pine	5	15, 128, 500
Yellow pine	5	15, 128, 500
Engelmann spruce	5	15, 128, 500
White fir	3	9, 077, 100
Noble fir	2	6, 051, 400
Tamarack Lovely fir Mountain fir Mountain hemlock	5	15, 128, 500
Total	100	302, 570, 000

WHITE SALMON RIVER WATERSHED.

Density of timber in White Salmon River watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2, 000	13, 370	13, 370, 000
2, 000 to 5, 000	23, 670	82, 845, 000
5, 000 to 10, 000	30, 650	229, 875, 000
10, 000 to 25, 000	5, 990	104, 825, 000
25, 000 to 50, 000	2, 890	108, 375, 000
50, 000 to 100, 000		
Total	76, 570	539, 290, 000

Average stand per acre for entire watershed, 5,106 feet B. M.

Area of timbered and other lands in White Salmon River watershed, Washington.

	Acres.
Timbered area	76, 570
Burned area	27, 200
Glaciers	450
Timberless area	1, 380
Total	105, 600

Proportions and amounts of timber species in White Salmon River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Yellow pine	40	215,716,000
Red or yellow fir	30	161,787,000
Tamarack	10	53,929,000
White pine	5	26,964,500
Hemlock	4	21,571,600
Noble fir	3	16,178,700
Red cedar	3	16,178,700
White fir Lovely fir Lodgepole pine Engelmann spruce Mountain fir Mountain hemlock	5	26,964,500
Total	100	539,290,000

KLICKITAT RIVER WATERSHED.

Density of timber in Klickitat River watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2,000	29,580	29,580,000
2,000 to 5,000	31,660	110,810,000
5,000 to 10,000	15,070	113,025,000
10,000 to 25,000	35,440	620,200,000
25,000 to 50,000	17,600	660,000,000
50,000 to 100,000	4,460	334,500,000
Total	133,810	1,868,115,000

Average stand per acre for entire watershed, 11,075 feet B. M.

Area of timbered and other lands in Klickitat River watershed, Washington.

	Acres.
Timbered area	133,810
Burned area	30,230
Glaciers	1,400
Timberless area	3,240
Total	168,680

Proportions and amounts of timber species in Klickitat River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Yellow pine	55	1, 027, 463, 250
Red or yellow fir	20	373, 623, 000
Tamarack	10	186, 811, 500
White pine	5	93, 405, 750
Mountain hemlock	5	93, 405, 750
White fir	5	93, 405, 750
Hemlock		
Engelmann spruce		
Mountain fir		
Lovely fir		
Red cedar		
Alaska cedar		
Lodgepole pine		
Total	100	1, 868, 115, 000

ATANUM RIVER WATERSHED.

Density of timber in Atanum River watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2, 000	12, 790	12, 790, 000
2, 000 to 5, 000	13, 240	46, 340, 000
5, 000 to 10, 000		
10, 000 to 25, 000		
25, 000 to 50, 000		
50, 000 to 100, 000		
Total	26, 030	59, 130, 000

Average stand per acre for entire watershed, 1,454 feet B. M.

Area of timbered and other lands in Atanum River watershed, Washington.

	Acres.
Timbered area	26, 030
Burned area	14, 630
Total	40, 660

Proportions and amounts of timber species in Atanum River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Yellow pine	60	35, 478, 000
Red or yellow fir	15	8, 869, 500
Tamarack	10	5, 913, 000
Mountain fir	5	2, 956, 500
Mountain hemlock	3	1, 773, 900
Lodgepole pine	2	1, 182, 600
White fir Lovely fir Engelmann spruce White pine Red cedar Alaska cedar	5	2, 956, 500
Total	100	59, 130, 000

TIETON RIVER WATERSHED.

Density of timber in Tieton River watershed, Washington.

Stand in feet B.M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2, 000	45, 270	45, 270, 000
2, 000 to 5, 000	71, 520	250, 320, 000
5, 000 to 10, 000	29, 970	224, 775, 000
10, 000 to 25, 000	4, 610	80, 675, 000
25, 000 to 50, 000	940	35, 250, 000
50, 000 to 100, 000		
Total	152, 310	636, 290, 000

Average stand per acre for entire watershed, 3,765 feet B. M.

Area of timbered and other land in Tieton River watershed, Washington.

	Acres.
Timbered area	152, 310
Burned area	16, 370
Timberless area	320
Total	169, 000

Proportions and amounts of timber species in Tieton River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Yellow pine	50	318, 145, 000
Red or yellow fir	35	222, 701, 500
Tamarack	10	63, 629, 000
Red cedar	5	31, 814, 500
Engelmann spruce		
White fir		
White pine		
Lodgepole pine		
Mountain fir		
Mountain hemlock		
Alaska cedar		
Total	100	636, 290, 000

NACHES RIVER WATERSHED.

Density of timber in Naches River watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2, 000	108, 500	108, 500, 000
2, 000 to 5, 000	188, 300	659, 050, 000
5, 000 to 10, 000	16, 000	120, 000, 000
10, 000 to 25, 000	5, 410	94, 675, 000
25, 000 to 50, 000		
50, 000 to 100, 000		
Total	318, 210	982, 225, 000

Average stand per acre for entire watershed, 3,002 feet B. M.

Area of timbered and other lands in Naches River watershed, Washington.

	Acres.
Timbered area	318, 210
Burned area	7, 510
Timberless area	1, 450
Total	327, 170

Proportions and amounts of timber species in Naches River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Yellow pine	45	442,001,250
Red or yellow fir	25	245,556,250
Tamarack	20	196,445,000
Hemlock	5	49,111,250
Red cedar White pine Lodgepole pine Noble fir Lovely fir White fir Mountain fir Mountain hemlock Engelmann spruce Alaska cedar	5	49,111,250
Total	100	982,225,000

YAKIMA RIVER WATERSHED.

Density of timber in Yakima River watershed, Washington.

Stand in feet B. M. per acre.	Number of acres.	Total stand.
		Feet B. M.
0 to 2,000	3,250	3,250,000
2,000 to 5,000	4,430	15,505,000
5,000 to 10,000		
10,000 to 25,000		
25,000 to 50,000		
50,000 to 100,000		
Total	7,680	18,755,000

Average stand per acre for entire watershed, 2,442 feet B. M.
Area of watershed, all timbered, 7.680 acres.

Proportions and amounts of timber species in Yakima River watershed, Washington.

Species.	Proportion.	Amount.
	Per cent.	*Feet B. M.*
Yellow pine	45	8, 439, 750
Red or yellow fir	30	5, 626, 500
Tamarack	10	1, 875, 500
Engelmann spruce	10	1, 875, 500
Mountain hemlock	5	937, 750
Mountain fir		
White fir		
White pine		
Lodgepole pine		
Red cedar		
Total	100	18, 755, 000

SUMMARY OF ESTIMATES.

Total timber estimates, arranged by watersheds.

Watershed.	Area.	Average per acre.	Total.
	Acres.	*Feet B. M.*	*Feet B. M.*
White River	156, 160	18, 544	2, 895, 920, 000
Puyallup River	117, 840	14, 428	1, 700, 230, 000
Nisqually River	78, 000	5, 414	422, 320, 000
Cowlitz River	291, 200	5, 611	1, 633, 905, 000
Cispus River	236, 000	7, 535	1, 778, 350, 000
Lewis River	222, 640	13, 295	2, 960, 005, 000
Washougal River	3, 280	26, 227	86, 025, 000
Rock Creek	6, 040	63, 005	380, 550, 000
Wind River	145, 000	25, 858	3, 749, 605, 000
Little White Salmon River	71, 650	4, 223	302, 570, 000
White Salmon River	105, 600	5, 106	539, 290, 000
Klickitat River	168, 680	11, 075	1, 868, 115, 000
Atanum River	40, 660	1, 454	59, 130, 000
Tieton River	169, 000	3, 765	636, 290, 000
Naches River	327, 170	3, 002	982, 225, 000
Yakima River	7, 680	2, 442	18, 755, 000
Total	2, 146, 600	9, 323	20, 013, 285, 000

Total timber estimates, arranged by species of trees.

	Feet B. M.		Feet B. M.
Red or yellow fir	8, 555, 218, 750	Tamarack	512, 385, 000
Hemlock	3, 533, 642, 000	Mountain hemlock	280, 677, 000
Yellow pine	2, 062, 371, 750	Engelmann spruce	271, 785, 000
Red cedar	1, 317, 078, 500	Mountain fir	200, 130, 000
Noble fir	1, 247, 883, 500	Alaska cedar	151, 326, 000
Lovely fir	749, 267, 500	Lodgepole pine	73, 267, 000
White fir	538, 735, 000		
White pine	519, 518, 000	Total	20, 013, 285, 000

COMMERCIAL USES OF TIMBERS.

In importance, all things considered, the principal timber trees of the reserve will at this time rank commercially in the following order:

Commercial rank of timber trees in Mount Rainier Reserve, Washington.

Red or yellow fir (Pseudotsuga taxifolia).
Red cedar (Thuja plicata).
Tide-land spruce (Picea sitchensis).
Yellow pine (Pinus ponderosa).
White pine (Pinus monticola).
Noble fir (Abies nobilis).
Lovely fir (Abies amabalis).
White fir (Abies concolor).
Hemlock (Tsuga mertensiana).
Tamarack (Larix occidentalis).

The above order results from size, quantity, and accessibility of the trees and the properties of the various woods.

If arranged in the order of the desirable properties of the woods and ignoring the question of size, quantity, and accessibility, the timbers will take rank as follows:

Rank of timber trees in order of desirable properties.

1. Alaska cedar
2. Noble fir
3. Tideland spruce
4. White pine
5. Red cedar
6. Red or yellow fir
7. Lovely fir
8. Hemlock
9. Yellow pine
10. White fir
11. Tamarack.

The uses to which the various woods are generally put are as follows:

Uses of woods of trees in Mount Rainier Reserve, Washington.

Bridge timbers	Red and yellow fir.
Lumber	Red and yellow fir, red cedar, tideland spruce, yellow pine, white pine, noble fir, lovely fir.
Shingles	Red cedar, white fir.
Piles	Red fir.
Telegraph poles	Red cedar.
Railroad ties	Tamarack, red and yellow fir, white pine, red cedar.
Fence posts and fuel	All kinds.
Paper pulp	The following trees in the order of their importance: Tideland spruce, cottonwood, quaking aspen, white fir, red and yellow fir, hemlock, maple.
Furniture and cabinetwork	In addition to the lumber woods enumerated some oak, ash, and maple have been used.

MARKETS AND PRICES.

In the absence of railroads and other well-established lines of travel the various divisions of the reserve are, by watersheds, commercially tributary to the outlying markets, namely, Tacoma, Chehalis, Portland, and North Yakima. The following tables show these watersheds and the markets which they at present would naturally supply.

Markets for watersheds in Mount Rainier Reserve, Washington.

Watersheds.	Area.	Tributary to—
	Acres.	
White River	156, 160	Tacoma.
Puyallup River	117, 840	Do.
Nisqually River	78, 000	Do.
Cowlitz River	291, 200	Tacoma or Chehalis.
Cispus River	236, 000	Do.
Lewis River	222, 640	Portland.
Washougal River	3, 280	Do.
Rock River	6, 040	Do.
Wind River	145, 000	Do.
Little White Salmon River	71, 650	Do.
White Salmon River	105, 600	Do.
Klickitat River	168, 680	Do.
Atanum River	40, 660	North Yakima.
Tieton River	169, 000	Do.
Naches River	327, 170	Do.
Yakima River	7, 680	Do.

Prices of fir lumber in markets adjacent to Mount Rainier Reserve, Washington.

Grade.	Size.	Finish.	Per M feet B. M. at—	
			Tacoma or Portland.	North Yakima.
	Inches.			
Common	1 by 12	Rough	$7.50	$13.50
Do	do	Surface 2 sides	10.50	16.50
Flooring V. G.:				
Number 1	1 by 4	Dressed and matched	19.00	24.50
Number 2	do	do	14.00	19.50
Ceiling:				
Number 1	$\frac{5}{8}$ by 6	Beaded and plain	15.50	19.00
Number 2	do	do	13.50	17.00
Wainscoting:				
Number 1	$\frac{5}{8}$ by 4		12.00	17.00
Number 2	do		10.00	15.00
Shiplap, common	1 by 8		8.50	14.50
Fencing:				
Number 1	1 by 4		7.50	14.50
Number 2	do		6.50	13.50
Pickets	1 by 3 or $1\frac{1}{4}$ by $1\frac{1}{4}$.		10.50	14.50
Lath	$\frac{3}{8}$ by $1\frac{1}{2}$ by 4 per 1,000.		1.65	2.75

Prices of cedar run from 25 to 40 per cent more than above.
Prices of spruce run from 10 to 50 per cent more than above.
Prices of hemlock run same as fir (no demand).
Shingles cost from $1 to $3 per thousand, according to quality.

Price of large or long dressed fir timbers at Tacoma.

Size.	Length.	Price per M feet B. M.
	Feet.	
8 by 8 inches	50	$12.50
8 by 8 inches	100	35.00
12 by 12 inches	50	12.50
12 by 12 inches	100	35.00
14 by 14 inches	50	13.25
14 by 14 inches	100	37.50
16 by 16 inches	50	14.00
16 by 16 inches	100	40.00
18 by 18 inches	50	15.50
18 by 18 inches	100	44.00
20 by 20 inches	50	17.00
20 by 20 inches	100	48.00
22 by 22 inches	50	20.00
22 by 22 inches	100	53.00
24 by 24 inches	50	23.00
24 by 24 inches	100	59.00

Prices of larger timbers are special.

UNDERBRUSH.

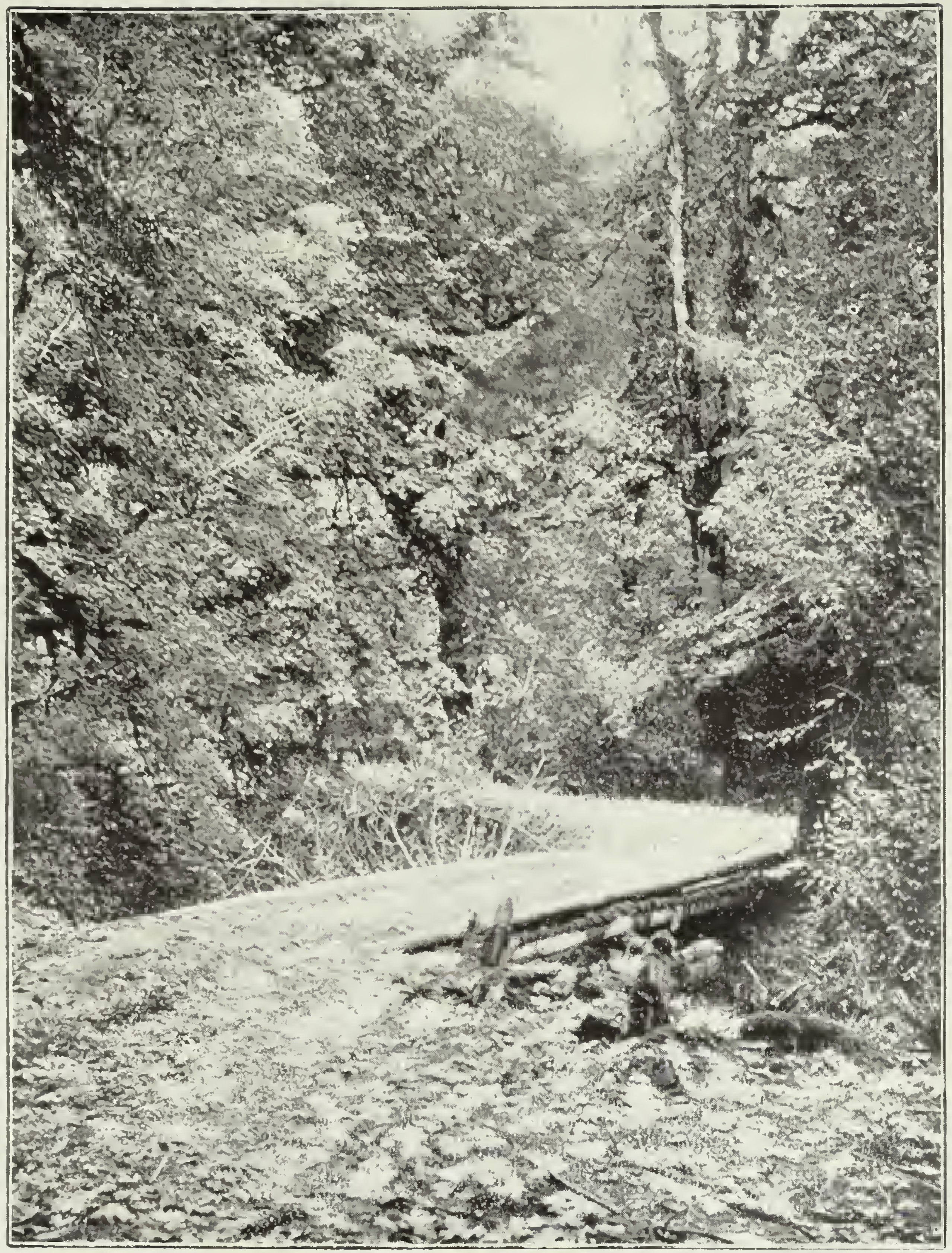
Small areas on the eastern slope are of open pine forests, carpeted with pine grass (*Calamagrostis suksdorfi*) and without litter or underbrush, but the general statement is true that on both slopes of the mountains the underbrush is heavy as compared with eastern forest areas, and on the western slope it is not uncommon for the growth to be so rank as to be impenetrable.

The term underbrush as here used does not include young trees of the same species as those composing the forest, nor does it include grasses, sedges, weeds, or ferns. In the typical forest of conifers there is considerable growth of the deciduous shrubs, which are properly included as underbrush and are so called locally. The species common to both slopes are as follows:

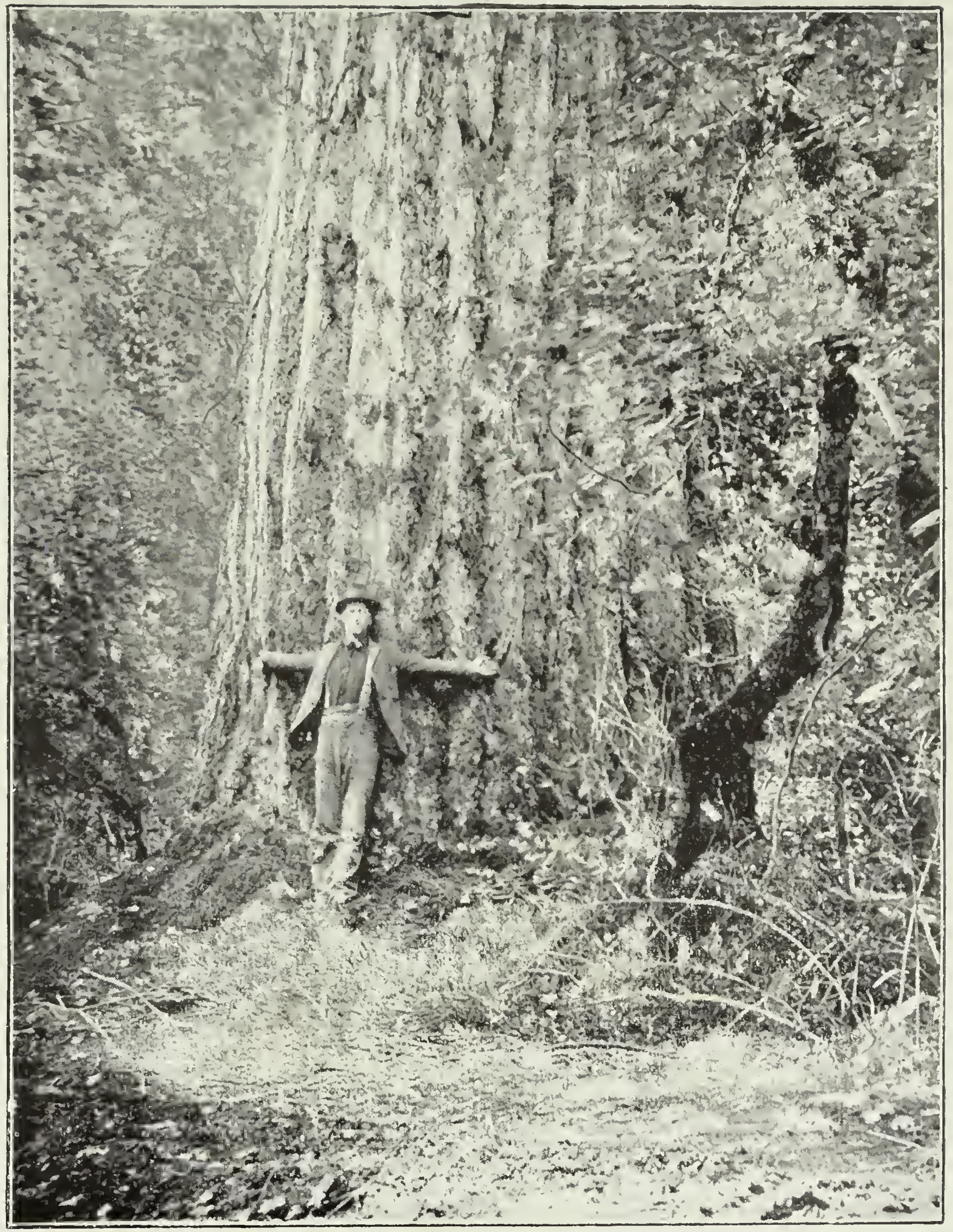
Underbrush in Mount Rainier Reserve, Washington.

SPECIES FOUND THROUGHOUT THE RESERVE.

Oregon grape	Berberis nervosa Pursh.
Washington holly	Berberis aquifolium Pursh.
	Pachystima myrsinites Raf.
Bearberry	Rhamnus purshiana DC.
Soapwood	Ceanothus velutinus Dougl., common.
	Ceanothus sanguineus Pursh.



A. MAPLE GROVE.



B. YELLOW FIR 12½ FEET IN DIAMETER.

Vine maple	Acer circinatum Pursh.
Smooth maple	Acer glabrum Torr.
Wild cherry	Prunus emarginata var. mollis Brewer. Prunus demissa Walp.
Wild rose	Rosa gymnocarpa Nutt. Rosa nutkana Presl. Rosa californica Cham. and Schlecht.
Hardhack	Spiræa douglasii Hook.
Arrowwood	Spiræa discolor Pursh.
Alpine spiræa	Spiræa rosea Gray.
	Spiræa corymbosa Raf.
Mountain ash	Pyrus sambucifolia (Cham. and Schlecht) Roem.
Crab apple	Pyrus rivularis Dougl.
Juneberry	Amelanchier alnifolia Nutt.
Thimbleberry	Rubus nutkanus Moc.
Salmon berry	Rubus spectabilis Pursh.
Raspberry	Rubus leucodermis Dougl.
Blackberry	Rubus ursinus Cham. and Schlecht.
Snowy or birds'-foot bramble	Rubus pedatus Smith.
Downy bramble	Rubus lasiococcus Gray.
Grease wood	Purshia tridentata DC.
Nine-bark	Neillia opulifolia B. and H.
Mock orange or wild syringa	Philadelphus lewisii Pursh.
Red-flowering currant	Ribes sanguineum Pursh.
Western fetid currant	Ribes bracteosum Dougl.
	Ribes viscosissimum Pursh.
	Ribes cereum Dougl.
	Ribes ciliosum Howell.
Prickly gooseberry	Ribes lacustre var. molle Gray.
Black-berried gooseberry	Ribes divericatum Dougl.
Devil's walking club	Fatsia horrida B. and H.
Canada dogwood	Cornus canadensis Linn.
Western dogwood	Cornus nuttallii Aud.
White-berried dogwood	Cornus pubescens Nutt.
White elder	Sambucus melanocarpa Gray.
Red-berried elder	Sambucus racemosa Linn.
	Sambucus glauca Nutt. ?
Viburnum	Viburnum pauciflorum Pylaie.
Snowberry	Symphoricarpus racemosus Michx.
Western honeysuckle	Lonicera ciliosa Poir.
Bush honeysuckle	Lonicera involucrata Banks.
Red huckleberry	Vaccinium parvifolium Smith.
Myrtle-leaved huckleberry	Vaccinium myrtilloides Hook.
Small red huckleberry	Vaccinium myrtillus var. microcephyllum Hook.
Cranberry	(species not determined.)
Manzanita	Arctostaphylos tomentosa Dougl.
Kinnikinick	Arctostaphylos uvaursi Spr.
Mountain salal	Gaultheria ovatifolia Gray.
Pale laurel	Kalmia glauca Ait. var.
	Menziesia ferruginea Smith.
White rhododendron	Rhododendron albiflorum Hook.

Labrador tea	Ledum latifolium Ait.
Dwarf birch	Betula glandulosa Michx.
Mountain alder	Alnus sinuata Ryd. Alnus rhombifolia Nutt.
Hazle	Corylus rostrata Ait., very common.
Bee willow	Salix sitchensis Sanson.
Marsh willow	Salix lasiandra Benth.
Quaking aspen	Populus tremuloides Michx.
Alpine juniper	Juniperus communis Linn.

SPECIES FOUND ONLY ON THE WESTERN SLOPE.

Madroña	Arbutus menziesii Pursh.
Salal	Gaultheria shallon Pursh.
State flower	Rhododendron californicum Hook.
Honeysuckle	Lonicera hispidula Dougl.
Black huckleberry	Vaccinium ovatum Pursh.

SPECIES FOUND ONLY ON THE EASTERN SLOPE.

Scrub oak	Quercus garryana Dougl.
Dogwood	Cornus stolonifera Michx.
Oregon grape	Berberis repens Lindl.
Sagebrush	Artemisia tridentata Nutt.
Missouri currant	Ribes aureum Pursh.
Small sagebrush	Aplopappus bloomeri Gray.

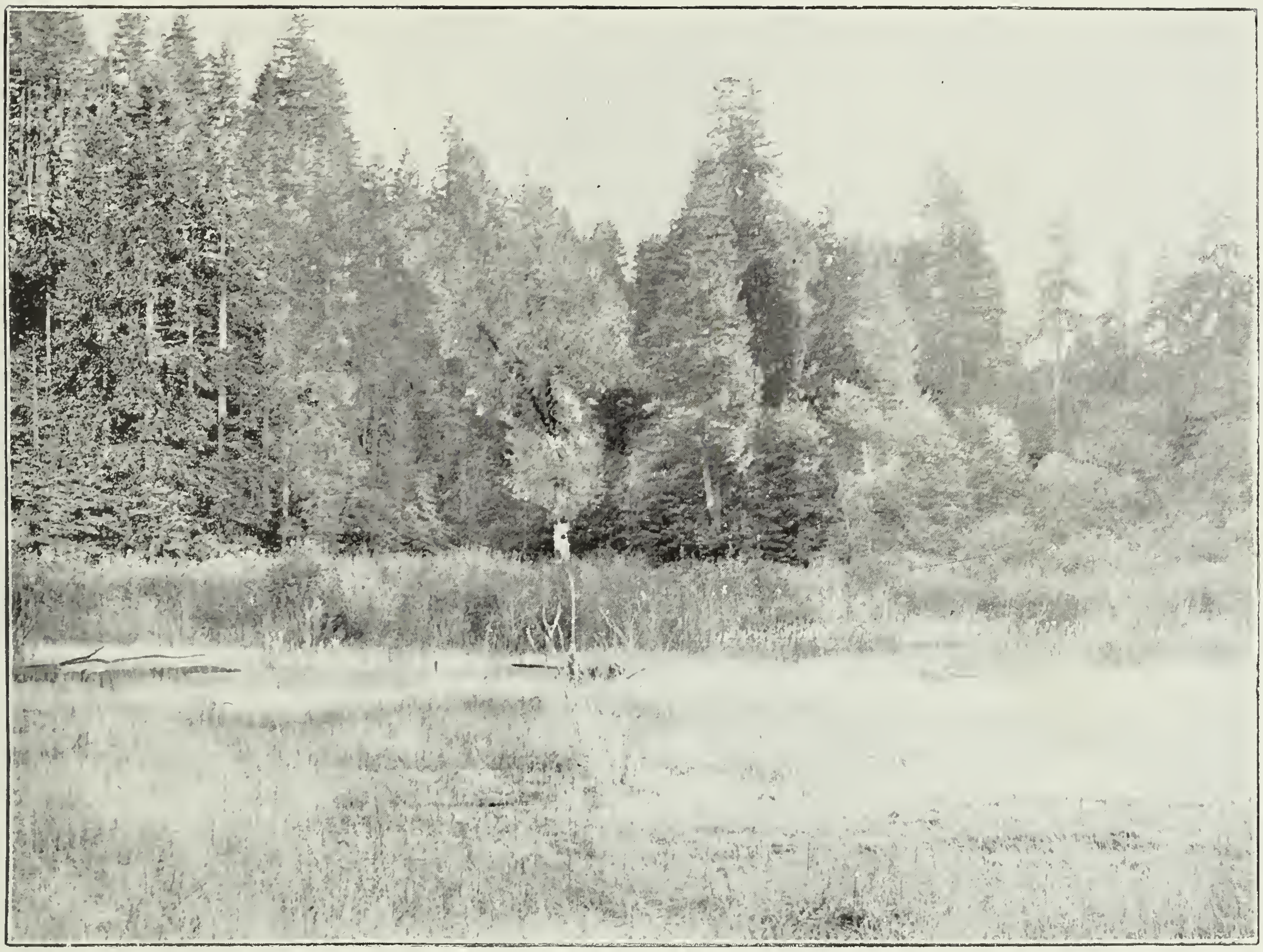
FOREST LITTER.

On the eastern slopes the forests are generally open, travel off the trails being possible with pack animals, although sometimes difficult and slow. On the western slopes the forest litter makes travel on the trails or roads imperative, and the explorer or prospector must expect to carry his pack on his back and climb over or crawl under the fallen logs that cover the ground. Sometimes these logs are piled 20 feet high, as mute but eloquent reminders of an unusually heavy windstorm. In such areas logging becomes difficult and expensive, as it increases the proportion of "swampers" in the logging crew.

The litter is a menace to the forest, inasmuch as it is the best conductor for fire, and when logs are favorably placed a heavy downpour of rain will not extinguish the flames, which, surviving, proceed with the work of destruction.

HUMUS.

An important factor in the forest growth is the humus, which forms the upper soil everywhere, excepting where the fires have been so severe as to utterly destroy it. This loose deposit of fallen and decayed vegetation is most abundant in the heavy and unharmed forests, where it is from 3 inches to a foot in depth. As it is a retainer of moisture and a protector for the seedlings, the restocking of burned areas is a slow process if the humus has been totally destroyed.



A. FIR, MAPLE, AND ASH TREES.

B. MOUNT HOOD; MOUNTAIN FIR IN FOREGROUND.

On the steeper hillsides it acts as a retarding element to the surface drainage, preventing the sudden flooding of the streams during rains, and also preventing their entire cessation during the dry season. On the eastern slope, in the watershed of the Yakima River, the surface flow continues to feed the river for three months after the cessation of the winter rains and snows, and as the waters of this river are largely used for irrigation, the importance of the forest cover and the humus is easily seen. Lands are irrigated from April to October, inclusive, the largest demand for water generally being made in July, at which time at least one-half of the flow is from the melting snows. The time is rapidly approaching when the entire flow of this river will be utilized in the necessary and desirable conversion of deserts into gardens, and it is conservative to say that a fall of 1 foot in the river affects 300,000 acres of land.

FIRES.

EXTENT AND LOCATION OF BURNS.

The areas which may be classified as burns amount to 326,590 acres, or about 15¼ per cent of the total area of the reserve. Of this area about two-thirds are on the western side of the Cascade Mountains.

Ancient burns, of which traces still remain in the standing timber, cover probably 40 to 50 per cent of the area of the reserve, but being restocked with trees of large size, these areas can not be called burns. The fires of comparatively recent occurrence, whose effects may be studied and compared, have results depending upon the nature of the forest, the time of year, and the winds. A fire may clear the ground of brush, litter, and humus, but not materially damage the standing trees beyond charring them to a height of 10 or 15 feet. If more severe it may consume some of the standing trees without much regard to species or location, on account of the proximity of underbrush and litter to the bases of the trees destroyed. Such fires leave standing burned snags surrounded by green and unharmed old timber.

A "burn" results in the total destruction of all vegetation within the limits of the burned area, leaving only standing snags and stumps, and the ground covered with partly consumed logs. Small areas may be "clean burns" and show few signs of the former forest, but instead be a desert of burned sandy soil in which the traveler will sink ankle deep. The burns bear little relation either to topography or the kind of timber, their boundaries and extent having been determined by the initial fire and the direction of the wind. The smaller deciduous trees which have their habitat in the moist bottoms, such as alder and maples, are more immune than their coniferous associates, but even they do not always escape.

The great burns in the Cowlitz watershed occurred in 1841 and 1856, but portions of the area have been burned or reburned at intervals during the past ten years. Over large and irregular areas this region is restocked with the same species of trees which border it and probably constituted the original forest. In this restocking the noble fir (*Abies nobilis*) takes an important part, and, together with the other firs, would rapidly retimber this most unsightly region if fires could be prevented. On the Sawtooth Range a large fire occurred in 1896, and reliable witnesses say that one tree burned for six months.

The hills on the north side of the Cowlitz River have been burned over several times since settlement, the last burn being three years ago. In this and adjoining areas the second growth after the burn is very rapid.

From testimony of various Indians regarding the "big fire" it appears that it was of unusual severity. Many Indians and stock perished, and the few saved who were in its path were submerged in the river for protection. The heat was so intense as to kill some of the fish in the river.

The large burn on Bald Mountain occurred about 1860 and must have been a very severe and destructive fire, destroying all the vegetation and humus and exposing the thin scoria soil, which barely covers the eruptive rocks. Under such adverse conditions the process of restocking is necessarily slow, particularly as the seedlings must advance up hill unprotected.

The burn about Juniper Mountain and the head of McCoy Creek occurred in July, 1898. At about the same time a portion of the southwest slope of Mount Adams was burned, leaving an unsightly patch of dead snags which detracts from the beauty of the mountain view.

The recent burns near Steamboat Mountain and over scattered patches to the southward have occurred periodically during the past twenty years, the last and most extensive fire being in 1897.

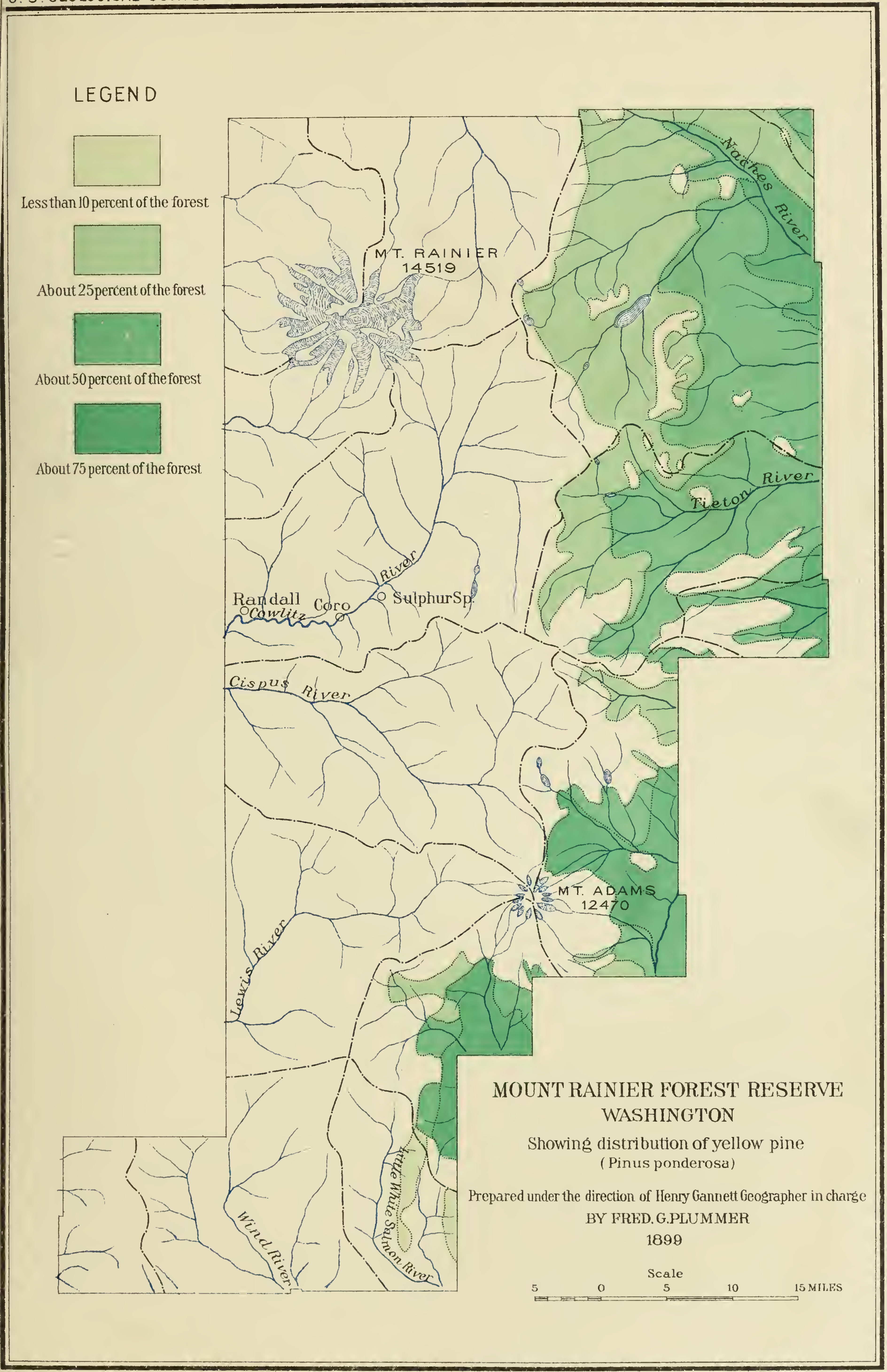
On the eastern slope of the Cascade Mountains the majority of the burns have occurred during the past decade, those of the Atanum and Tieton watersheds having mostly occurred since 1896.

A portion of the basin of Silver Creek was burned August 10, 1898, and at this time ashes fell at Longmires Springs, which is distant about 20 miles. Mineral Creek Basin, which is a tributary to American River, burned over in 1895.

CAUSES OF FIRES.

The fires which have occurred in the reserve may be traced to the following causes:

Campers and packers build their fires against logs or trees and neglect to extinguish them. Small fires that are built in the open do


LEGEND
🟩 Less than 10 percent of the forest
🟩 About 25 percent of the forest
🟩 About 50 percent of the forest
🟩 About 75 percent of the forest
MT. RAINIER
14519
Naches River
Tieton River
River
Randall
Cowlitz
Coro
Sulphur Sp.
Cispus River
MT. ADAMS
12470
Lewis River
Wind River
Little White Salmon River
Scale
5 0 5 10 15 MILES

MOUNT RAINIER FOREST RESERVE
WASHINGTON
Showing distribution of yellow pine
(Pinus ponderosa)
Prepared under the direction of Henry Gannett Geographer in charge
BY FRED. G. PLUMMER
1899

JULIUS BIEN & CO. LITH N.Y.

not spread unless the humus is deep and dry. They will smolder until fanned into flame by the wind.

Sheep men start fires to promote the growth of grass near the summits, believing that the destruction of the timber is generally followed by a growth of those grasses upon which sheep will feed. Severe fires also have the effect of clearing the ground of underbrush and litter and make it easier and safer to drive sheep from point to point.

Prospectors fire the timber with the object of clearing the ground to make prospecting easier. A great many miners are strongly opposed to this method as it gives a very dirty area to work in and the legitimate miner needs the timber for his shafts and tunnels.

Settlers start fires for the purpose of clearing the land for cultivation. As the settlers do not like to go to the trouble of carrying their brush or slashed timber away from the standing timber, they burn it where it falls in slashing.

Indians also start fires on the slopes and summits for the purpose of promoting the growth of huckleberries, blackberries, and raspberries, and also to drive game.

Camping parties often set fire to the resinous trees simply for the the pleasure of seeing them burn. Cases of this kind were not uncommon, but of recent years sentiment has been so strongly against this practice that the evil has almost ceased to exist.

Lightning also starts fires.

Since the inauguration of the present forest policy the causes may be briefly stated as ignorance, carelessness, and lightning. The expert woodsman, trapper, hunter, or camper for pleasure is careful about his fires and knows how to build them so that they will not spread and burn his tent and outfit. His cooking fire is never larger than necessary to hold a coffee pot, kettle, and skillet, and is usually made between two rows of rocks or two small green or wet logs. The fire will measure 8 by 20 or 30 inches, and within a half hour from the time of starting every small twig and dry cone in its immediate vicinity has been used for fuel and to safeguard against burnt shoes or trousers. The tenderfoot, on the contrary, builds his fires large and open, and the chance of their spreading is much increased if they are against logs or trees.

The fixing of a cause for any stated fire is almost impossible, unless lightning was the cause. Sheep men, prospectors, hunters, and ranchers accuse one another promiscuously, but no reliable data are obtainable. In the case of lightning, where the agency of a human being is not involved, some data have been collected and will be here given at the risk of giving that agent more prominence than might be justified were the other causes capable of the same investigation. These well-authenticated instances do, however, prove that lightning can not be omitted from the list of causes, although it may be argued that during an electric storm the precipitation should be so great as to prevent a large fire from catching or spreading.

In May, 1897, lightning struck the timber in Cowlitz Bottom near the town of Vance on several occasions, the largest burn resulting in the destruction of about three acres of timber. In June, 1896, it struck the hills in secs. 1 and 2, T. 12 N., R. 7 E., and a large forest fire in the second growth resulted.

Timber on Juniper Mountain was struck by lightning in July, 1898, and a large burn resulted which destroyed considerable fair timber.

In the basin of the South Fork of the Rattlesnake on July 22, 1898, at 7.30 p. m., lightning struck a tree and also killed three horses belonging to Joseph Melini. Another stroke set a small fire which burned for ten or fifteen minutes. Both fires were extinguished by the accompanying downpour of rain.

On August 10, 1898, lightning struck several trees in Silver Creek Basin and a large burn resulted. There was no rain that day, nor was there at Longmires Springs, distant 20 miles, although the day was heavily clouded.

Two fires were started by lightning on July 28, 1899, in sec. 36, T. 7 N., R. 9 E., but did not spread beyond the trees struck.

RESTOCKING OF BURNED AREAS.

All of the restocking of the reserve is natural. No work has been done by man toward reseeding with the best species nor eliminating from young second growths the undesirable species. All of the activity thus far has been toward protection against fire, which may in a day destroy what would balance the work of years.

The process of reseeding is rapid. All of the timber trees seed abundantly and at a season when the high winds may distribute the seeds over large areas. It is doubtful if any assistance from man would noticeably affect the progress of this reseeding, which, if conditions of soil permit, results in a thicket of small growth in spite of the numerous animals which destroy seeds. In cases where a fire was not severe and representatives of one or more hardy species withstood the flames, the restocking begins from these survivors, which are not always the best timber species. The mountain hemlock (*Tsuga pattoniana*) seems to resist fire more successfully than the other species common in the alpine zone, and the tamarack (*Larix occidentalis*) survives best in the middle zone. In Naches Valley above the junction of Bumping River there is a very old burn. A few yellow pine and red fir of the old forest are still standing, and the heavy second growth is of the same species, with the addition of tamarack. Very small recent fires in the same area have injured many of the trees and made clean burns in some locations. From Naches Pass just outside the reserve for 5 miles down the river and into the reserve there is an

A. MOUNT RAINIER FROM GOAT MOUNTAIN.

B. BURN, WITH SECOND GROWTH.

old burn about 2 miles wide, which is now partly second growth white fir and tamarack, with willows along the banks. In the watershed of Atanum River there are indications that the tamarack stood the fires of an ancient burn better than other species.

After a clean burn the restocking must proceed from the bordering forests, and it is observed that although these bounding forests may be mixed, one species often predominates in the new growth. This fact may be accounted for by assuming that a favorable wind prevailed when that particular species was in mature fruit, and that the soil conditions in the burn were such as to give encouragement to that species. In this respect the tamarack easily takes the lead in eastern Washington, and the hemlock (*Tsuga mertensiana*) in western Washington. Of all the conifers these two species have the lightest cones and seeds, and are most exempt from the attacks of squirrels and chipmunks. These are among the least valuable of the timber trees, and it happens that the best of the pines, the white pine (*P. monticola*), and the best of the firs, the noble fir (*A. nobilis*), have large and heavy cones, and being subject to these depredations are checked in their efforts at restocking.

The grazing of sheep and other stock upon burned areas certainly retards their restocking with timber. If stock pasturing were prohibited upon all burned and low timberless areas until the restocking had resulted in such sufficient stand and age of timber trees that further protection would be unnecessary, it would remove a serious enemy from the field, and in all probability would result in extinguishing forest fires in their incipiency.

TIMBERLESS AREAS.

There is no altitude which may be termed a timber limit. This results from the fact that the bold topography of the reserve and the presence of numerous perpetual snow fields and glaciers cause different climatic conditions to obtain in areas not widely separated. Upon the slopes of Mount Rainier the alpine trees cover the sharp ridges to an elevation of 7,200 feet, and above this only a few scattering procumbent individuals find shelter behind some rock or crag. The extreme altitude there reached by trees may be stated at 7,600 feet, but at Goat Peak the same forms reach an altitude of 8,400 feet. The difference of latitude favoring Goat Peak is only a third of a degree, but the local climatic conditions are quite different. At lower elevations than these, however, many rocky peaks are often too exposed to permit a growth of trees or the accumulation of a scanty soil, excepting in the rock crevices where the hardy little alpine flowers will find strong root hold.

Cliffs at all altitudes are often too steep and smooth to permit the spread of the timber which struggles for existence on the talus slopes below. Often the talus slopes are timberless, particularly when recent or when composed of fine chips, but in the majority of cases the pines and firs manage to advance over these uninviting areas.

Upon the slopes of Mount Rainier the glaciers flow to the lower altitudinal limit of 3,300 feet, and these areas are of course timberless, as are the perpetual snow fields which border the glaciers or lie upon the ridges which form the divides between the "cradles" of the glaciers.

The great timberless area of eastern Washington, or the "arid region," does not extend to the boundary of the reserve, but approaches it so closely that it is germane to the subject.

It appears to the most casual observer that the trees of the lower mountain slopes are forcing their way over these arid regions. A similar phenomenon has long been observed on the beautiful parked prairies of western Washington near Tacoma, where the advance of the red firs (*Pseudotsuga taxifolia*) has been as great as 25 feet per year. On the eastern slopes of the Cascade Mountains it is the yellow pine (*Pinus ponderosa*) that takes the lead among the conifers in attacking these arid regions. The red fir follows closely, seldom being more than 2 miles behind, and is in turn closely followed by the tamarack (*Larix occidentalis*). Other species follow rapidly, depending upon topography and soil.

TIMBER CUTTING IN THE RESERVE.

A total area of about 8,000 acres has been cut within the boundaries of the reserve. Of this amount 40 per cent has been cut by actual settlers and the balance by loggers.

The largest area is along Tieton River, from the reserve boundary westward. The lumber is reported as used for fluming and other construction work on the Selah irrigating canal. The cordwood from the same area was marketed in North Yakima.

At Tannum Lake about 200 logs have been cut and dressed on two sides ready for the construction of an impounding dam at the foot of the lake. This work was done in 1891 under the direction of the Yakima Investment Company, and most of the logs have been piled up at the point of proposed construction. Tannum Lake and Lakes Kitchelos, Katchess, and Clealum, which lie outside of the reserve, have been considered in connection with the extensive plans for the irrigation of the fertile slopes of the Lower Yakima Basin, which plans have been partly carried to completion. There is little doubt that they will be needed for storage in the future, as the nature of the Yakima watershed causes extremes of high and low stages in the river.

At the Medina mining camp on Silver Creek in Summit district, a small mill has been erected to furnish lumber to be used in the construction of a 5-stamp mill and the necessary fluming and buildings.

A. SUMMIT OF RANGE IN SOUTHERN PART OF THE RESERVE, LOOKING WEST.

B. HEADWATERS OF TIETON RIVER, FROM GOAT MOUNTAIN.

They have slashed an area of about 2 acres and cut a total of about 10,000 feet.

A sawmill in sec. 29, T. 15 N., R. 7 E., was run for a short time. The logging was largely from an area subsequently cleared and cultivated. There are about 10,000 feet of lumber in the mill yard.

A mill situated near Chenowith post-office in sec. 22, T. 4 N., R. 9 E., has cut a total of about 40 acres from patented land within the reserve. Another located in sec. 14, T. 3 N., R. 9 E., outside of the reserve, has cut about 160 acres.

A shingle mill is situated in sec. 20, T. 4 N., R. 9 E., and has a capacity of about 30,000 shingles per day. It cuts from patented lands.

In 1899 a small portable mill was located in sec. 8, T. 12 N., R. 7 E., but is now idle after filling a few small orders. The country tributary to it is patented and settled.

LOGGING CONDITIONS.

It may be said generally that the logging of those areas examined must be by skid and railroads. The only drivable stream is the Lower Cowlitz River, and as there is not much timber in its valley skids or trams will be needed to transfer logs from the timbered slopes of its watershed to the river. The exception to the above general statement is that during flood seasons several of the rivers carry enough water in confined channels to drive logs for short distances, and that shingle bolts, fence posts, and cordwood might be driven during the greater part of the year if drifts and other obstructions are removed. Such rivers are the White, Carbon, Little White Salmon, Cispus, Lewis, Wind, Puyallup, Nisqually, Klickitat, and Naches. With the present method of logging it is not likely that any of these streams will ever be used.

In all the watersheds the method and route of logging is fixed by the location of the main and secondary divides, which are usually sharp and well defined, without table-lands. In such cases the canyon slopes are so steep that log chutes might be used, but the areas tributary to such chutes are generally limited and contain little timber.

With the exception of a short narrow-gage railroad feeding the Oregon Mill Company's mill in T. 4 N., R. 9 E., there are no railroads in the reserve, nor are there any wagon roads over which heavy logs could be hauled. The Northern Pacific Railway Company has made a survey up the Nisqually Valley via Bear Prairie, down Skate Creek, up the Cowlitz and Summit Creek and over Carlton Pass in the Cascade Mountains, thence down Bumping River, but no construction work has been done. The Tacoma and Columbia River Railroad has made a preliminary survey from the end of their line at Lake Park, 11 miles from Tacoma. This survey runs up the Cispus River to Cispus Pass with the expressed intention of tapping a timber belt and certain coal prospects in the Cispus watershed.

SETTLEMENT AND IMPROVEMENTS.

Within the reserve there are 160 settlers, of whom about 75 per cent have made improvements other than the building of houses or cabins. From detail memoranda made during the examination the following figures are obtained:

Improvements in Mount Rainier Reserve, Washington.

Number of houses (including trappers and prospectors)	181
Number of barns	90
Number of acres slashed	3, 275. 85
Number of acres cleared (mostly in pastures)	1, 864. 75
Number of acres in gardens	65. 4
Number of acres in orchards	91. 85

Generally the clearing of land for pasturage does not include the removal of large stumps, as this work is expensive, and in some locations would mean $150 per acre. The garden produce is for local consumption and is only limited by climate. The best results are from potatoes, onions, turnips, carrots, beets, parsnips, squash, and small fruits. Corn, tomatoes, and cucumbers are raised, but not to perfection. The orchards are principally of apples, plums, and pears.

GRAZING.

The grazing lands of the reserve are mainly upon the eastern slope of the Cascade Mountains, and have an area of about 800,000 acres.

During the season of 1899 approximately 260,000 sheep were herded on this area. The general method of herding sheep in the State of Washington is as follows: In the late fall and winter the sheep are pastured in the vicinity of their home ranches in the low lands and valleys of eastern Washington, and in severe weather feed on hay. In the early spring, after lambing and shearing, the bands are driven toward the mountains, reaching the reserve in June. They follow the receding snows to the very summits, grazing and browsing upon the new growth of grasses and deciduous vegetation. Late in August they commence to work down to the lower altitudes, and generally leave the reserve about the 1st of October.

As might be expected, there is a wide divergence of opinion regarding the advantages or disadvantages resulting from this practice, and the sheep owner's position has become one of active defense against public sentiment.

The arguments presented against the grazing of sheep in the reserve are as follows: (1) That the sheep men fire the forests for the purpose of promoting the growth of the forage plants. (2) That the sheep browse upon the young timber trees and trample out the seedlings. (3) That the removal of underbrush causes the streams to become more

A. MOUNT ADAMS.

B. CISPUS RANGE, FROM GOAT MOUNTAIN.

sensitive to melting snows, and the summer flow of rivers used for irrigation is thereby decreased. (4) That the sheep pollute the streams. (5) That the natural beauty of the reserve is partially destroyed.

The sheep owners and herders not only deny all the above, but claim in addition: (1) That the removal of the underbrush by the browsing of sheep lessens the liability of fires spreading. (2) That the herders are exterminating the bears, cougars, wildcats, wolves, and coyotes, which prey upon domestic animals.

There is little doubt but that sheep men have started fires, and that burns more or less extensive have resulted, but it is equally true that by reason of the strict regulations and enforcement of the law, together with a regard for their own interests, due to a wholesome fear of the cancellation of their permits, the practice has ceased, and any fires now originating with the sheep men are isolated cases resulting from carelessness.

Moreover, it is contended that setting fire to the timber does not necessarily result in the increase of the areas for pasturage. A clean burn more frequently results in a rank growth of huckleberries, and if the burn is not clean the ground remains covered with charred logs and snags, making travel slow and dangerous and the area often unfit for sheeping. The coarse grasses and weeds that immediately follow the fires are not the best forage, and it may be several years before they are succeeded by the better varieties.

It is a fact that the greatest number of burns and also those of the greatest extent are in portions of the reserve which have not been sheeped, and this fact has at least a general bearing on the subject, as these areas of great burns are on the western slopes and in the regions of greatest annual precipitation.

The claim that the sheep browse upon the young timber trees is not well founded so far as it relates to the conifers, and within the grazing area there are no deciduous trees of any value excepting the oak (*Quercus garryana*), and that is generally of a size only fit for fuel. Sheep, cattle, and horses will not eat foliage from the pines, firs, and other evergreens which comprise the timber of the reserve, unless driven to it by a hunger that is almost starvation. In the immediate vicinity of the separating corrals, where bands of sheep may be confined for one or two days during the process of separating, small evergreens were nipped by the sheep, and along the beaten and oversheeped trails the same thing may be noticed, but the damage is insignificant and only worthy of mention as an exception. During the examination our pack animals were several times in desperate need of pasturage, as our route of travel took us over miles of deep snow, which covered everything but the timber trees. These, however, the animals would not touch. On Pisco Ridge (outside the reserve), at an elevation of 6,000 feet, we found the remains of over 20 horses, which had perished in the snow, huddled together in a bunch of young firs and pines. They had pawed the ground for grass roots, and had gnawed the bark from the trees and browsed on some of the foliage, but not to any extent.

There is no doubt that the sheep trample out seedlings of the conifers as they do of other trees and shrubs. Along the routes of sheep travel the forest floor is sometimes powdered by their sharp hoofs and all traces of undergrowth obliterated, and if this condition prevailed over a burned area the process of restocking would be very slow.

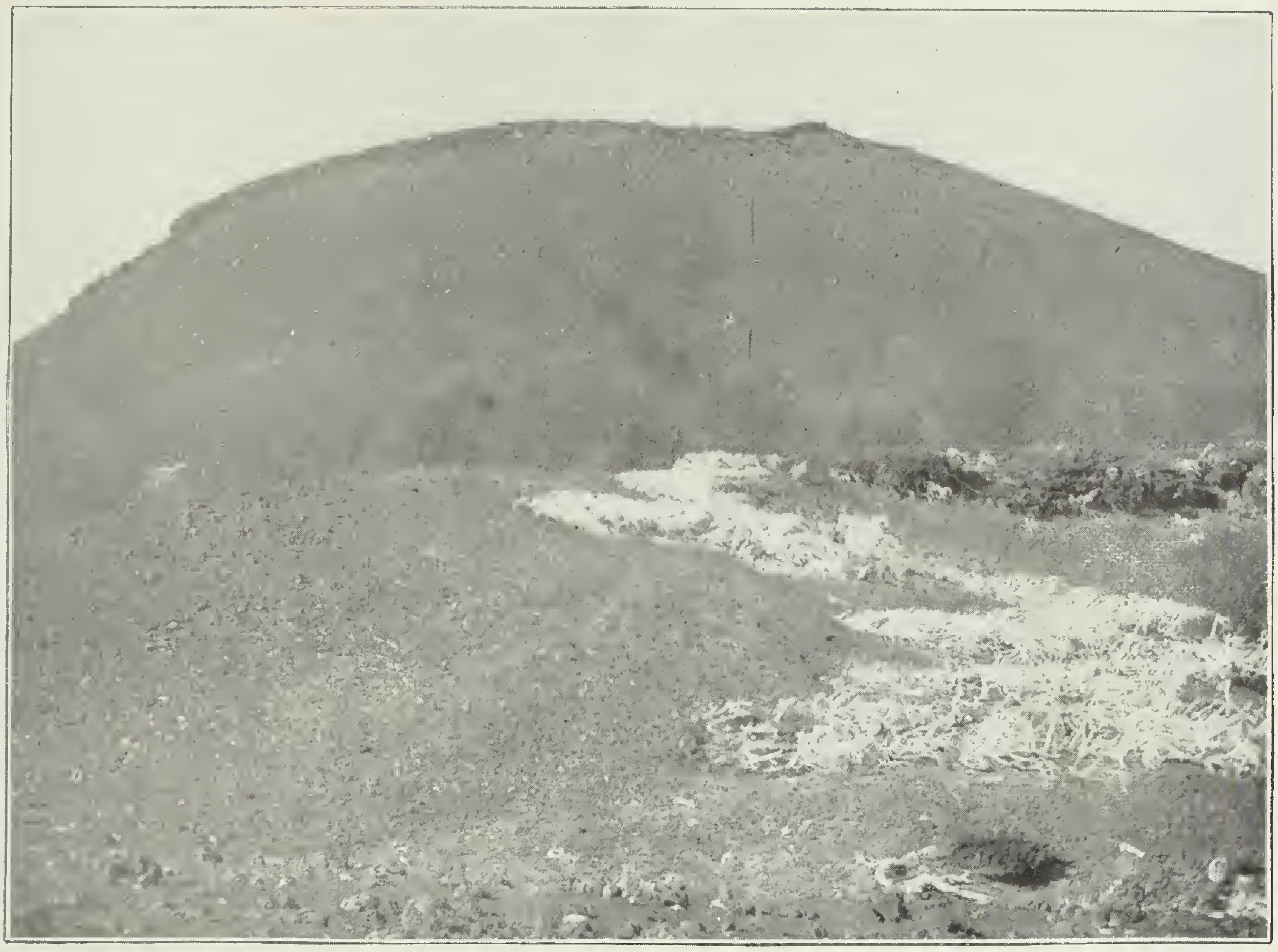
All of the conifers set cones in abundance, but not one seed in 100,000 produces a mature tree under ordinary conditions. Squirrels, chipmunks, and birds eat most of the seeds; forest shade kills many of the seedlings, and in the open it is a case of survival of the fittest. Inasmuch as a sufficient number of the seedlings generally survive to take part in the final competition and form the "thickets" so commons in the more open areas, it is evident that the enemies, including sheep, do not seriously affect the final result as stated.

The effect of underbrush and forest cover in retarding or accelerating the melting of snow is easily demonstrated by observation in the area of the Cascade Mountains examined. However, if it be assumed that the snow melts more quickly in the open many locations may be cited as evidence, and if the contrary be assumed the evidences are quite as numerous. This is for the general hypothesis, but there are details of exposure and altitude which enter into the problem and make it capable of solution. The masses of compact snow which are found in the open or timberless heights late in the summer are always upon hillsides protected from the warm chinook winds, and these are generally the northern and eastern slopes. Upon timbered mountains of equal altitude and where similar climatic conditions prevail the same slopes hold snow the longest. The effect of the underbrush and forest litter on the melting of snow is one which the traveler in these high altitudes is forced to observe for his own safety. It is only upon the hard snow which hides no brush or logs that safe footing is found. Wherever a log or brush exists the snow is soft and melting and the pack animals and men fall through, a matter of some consequence where the snow is over 6 feet deep.

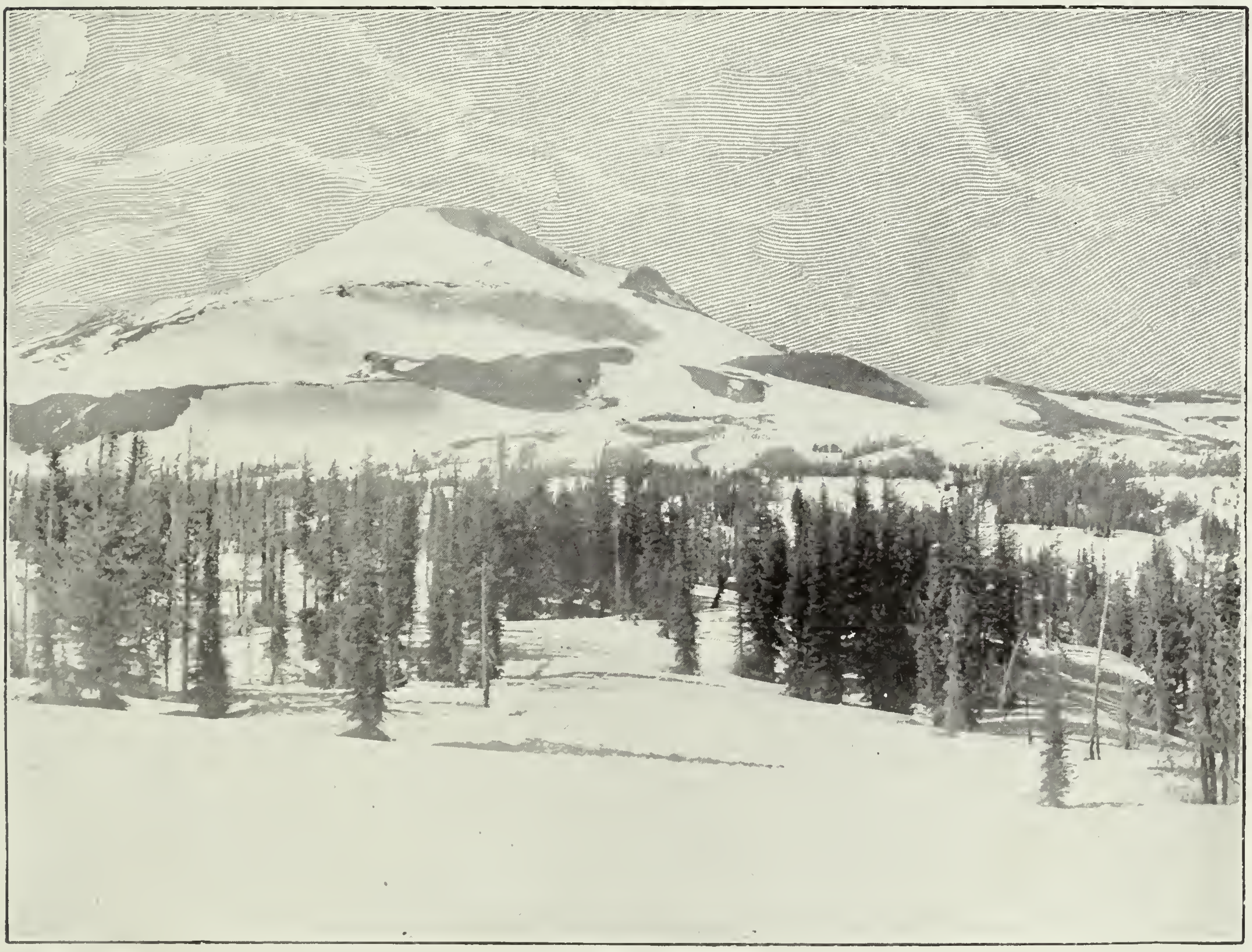
Although the temperature in the forest may be slightly higher than in the open, for any given altitude, there can be no doubt that a stand of timber protects the snow from the warm winds and prevents the sudden rise of a stream. The underbrush does not give this protection, but is an agent in preventing the compacting and hastens the melting of the snow. To summarize: The snows will remain longest (other conditions equal) in—

(1) A forest without underbrush or litter.

(2) An open without brush or litter.



A. RECENT CINDER CONE ON NORTH SLOPE OF MOUNT ADAMS.



B. MOUNT ADAMS, WITH MOUNTAIN FIR IN FOREGROUND.

(3) A forest with underbrush or litter.

(4) An open with brush or litter.

The question of the pollution of the streams by sheep is one rather for the future than for the present, inasmuch as provision is made that the sheep "shall not be corralled within 500 yards of any running stream or living spring." If the corrals bordered on or had surface drainage into the streams the waters would be polluted in sentiment if not in fact when they reached the distant settlements, and sentiment is a strong factor when it applies to drinking water. One specification for good drinking water is that it must not contain more than one part by weight of dry organic matter in 100,000 parts of liquid, and it is safe to say that this limit is not exceeded in the river waters even in the immediate vicinity of the corrals. The fact that running waters are self-clarifying is generally conceded, although not to the extent set forth by Dr. H. Letheby, medical officer of health for the city of London, in relation to the Thames. His statement is that "sewage" when it is mixed with twenty times its volume of running water and has flowed a distance of 10 or 12 miles is absolutely destroyed; the agents of destruction being infusorial animals, aquatic plants and fish, and chemical oxidation. The question of pollution is therefore one to be considered in the precautionary way, and this has been done.

The scenery of the reserve is on too grand and extensive a scale to be affected by any operation of man, such as grazing or mining. The burns are the only disfigurement to the magnificent views which reward the climber of the peaks. Areas of particular beauty or novelty should be included in the National Park, on which pasturing is not allowed.

The Secretary of the Interior on June 30, 1897, promulgated rules and regulations relating to forest preservation, among which was the following: "13. The pasturing of live stock on the public lands in forest reservations will not be interfered with so long as it appears that injury is not being done to the forest growth and the rights of others are not thereby jeopardized." From my observations the injury done the forest growth by sheeping is not serious, and the attendant evils can be and are being guarded against.

OLYMPIC FOREST RESERVE, WASHINGTON

FROM FIELD NOTES

BY

ARTHUR DODWELL AND THEODORE F. RIXON

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OLYMPIC FOREST RESERVE, WASHINGTON.

From field notes by ARTHUR DODWELL and THEODORE F. RIXON.

LOCATION AND BOUNDARIES.

This reserve is situated in the northwestern part of Washington and occupies most of what is known as the Olympic Peninsula. Its original limits, as set forth in the executive order of President Cleveland of February 22, 1897, were as follows:

Beginning at the southeast corner of township twenty-one (21) north, range five (5) west, Willamette base and meridian, Washington; thence northerly along the surveyed and unsurveyed range line between ranges four (4) and five (5) west, to the point for the northeast corner of township twenty-three (23) north, range five (5) west; thence easterly along the unsurveyed and surveyed township line to the point for the southeast corner of township twenty-four (24) north, range four (4) west; thence northerly along the unsurveyed range line to the point for the northeast corner of said township; thence easterly along the unsurveyed and surveyed sixth (6th) standard parallel north, to the southeast corner of township twenty-five (25) north, range three (3) west; thence northerly along the surveyed and unsurveyed range line between ranges two (2) and three (3) west, to the northeast corner of township twenty-nine (29) north, range three (3) west; thence westerly along the surveyed and unsurveyed seventh (7th) standard parallel north, to the point for the southeast corner of township thirty (30) north, range nine (9) west; thence northerly along the unsurveyed and surveyed range line to the northeast corner of said township; thence westerly along the township line between townships thirty (30) and thirty-one (31) north, to the northeast corner of township thirty (30) north, range fourteen (14) west; thence northerly along the range line to its intersection with the shore of the Strait of Juan de Fuca; thence northwesterly along said shore line to the east boundary of the Makah Indian Reservation; thence southerly along the east boundary to the southeast corner of said reservation and westerly along the south boundary thereof to the high-water mark on the Pacific coast; thence southerly along said coast line to the north boundary of the Quinaielt Indian Reservation; thence southeasterly along the north boundary to the eastern point of said reservation and southwesterly along the south boundary thereof to the point of intersection with the fifth (5th) standard parallel north; thence easterly along said parallel to the southeast corner of township twenty-one (21) north, range five (5) west, the place of beginning.

On April 7, 1900, this reserve was reduced by the elimination of the following tracts, all situated in Clallam County. Most of these areas were withdrawn from the reserve because a large proportion of the land had been alienated by the Government:

Townships twenty-eight (28) north, ranges thirteen (13) and fourteen (14) west, Willamette base and meridian, Washington; fractional township twenty-eight (28) north, range fifteen (15) west; sections one (1) to eighteen (18), both inclusive, townships twenty-nine (29) north, ranges three (3), four (4), and five (5) west; sections four (4), five (5), six (6), seven (7), and the north half of section eight (8), township twenty-nine (29) north, range twelve (12) west; all of township twenty-nine (29) north, range thirteen (13) west, except sections thirteen (13), twenty-three (23), twenty-four (24), twenty-five (25), and twenty-six (26); township twenty-nine (29) north, range fourteen (14) west; fractional township twenty-nine (29) north, range fifteen (15) west; sections one (1) to twelve (12), both inclusive, township thirty (30) north, range nine (9) west; sections twenty-seven (27) to thirty-four (34), both inclusive, township thirty (30) north, range ten (10) west; sections twenty-five (25) to thirty-six (36), both inclusive, township thirty (30) north, range eleven (11) west; sections seventeen (17) to thirty-six (36), both inclusive, township thirty (30) north; range twelve (12) west; townships thirty (30) north, ranges thirteen (13) and fourteen (14) west; and township thirty (30) north, range fifteen (15) west.

The reserve comprises an area of 3,030 square miles, or 1,939,200 acres, and includes parts of Clallam, Jefferson, Chehalis, and Mason counties.

The work of examining this reserve has been carried on during the seasons of 1888 and 1889 by Messrs. Arthur Dodwell and Theodore F. Rixon. During the first season they examined 10 townships situated in the eastern part of the reserve. During the past season they examined 61 townships, comprising the northern and most of the western part of the reserve, the total area examined in these two seasons comprising 71 townships, several of them being partial or fractional townships. The total area examined during these two seasons was 2,400 square miles. As these examinations were made prior to the reduction in the reserve which was above noted, they include the areas which have since been withdrawn from the reserve, and, as matters of information, their description of the townships and portions of townships since withdrawn from the reserve are here given.

This area, with its topographical and general forest characteristics, is shown on Pl. LI, in the atlas. Considering the areas gone over, the examinations were exceedingly minute. They included estimates for each section of the following items of information: The timbered, burned, cut, and nontimbered areas, the depth of humus and forest litter, the total stand of timber, and the stand of the principal species recognized by the lumber trade, the average height, diameter, and clear length, and the percentage of dead and diseased trees. Of course it is understood that these are estimates only, but they are estimates based on observation and made by the best of trained observers, by men who for many years have followed the profession of estimating the stand of timber.

TOPOGRAPHY.

The reserve includes the Olympic Mountain group, with its slopes on the north, east, and south, together with a considerable extent of low country on the west stretching to the Pacific Ocean. The mountains rise to peaks exceeding 8,000 feet in altitude, with considerable areas above timber line, here ranging from 5,500 to 6,000 feet. At great altitudes there are considerable areas of upland pasture. These mountains contain many glaciers which, though individually of small size, cover collectively a considerable area. Much of the land in the higher part of the mountains, though not sufficiently elevated to prevent the growth of trees, is barren and rocky, having slopes so steep that soil and trees have been unable to find a footing.

The country is drained by several large rivers which rise in the higher mountains and are fed continually by perpetual snow and glaciers. The principal of these are the Dungeness, Elwha, Soleduck, Kalawa, Bogachiel, Dickey, Hoko, Hoh, and Queets, with the Dusewallips and Quilcene on the east draining to Hood Canal. The largest of these is Hoh River, which drains the central mass of Mount Olympus, the highest peak of the group, 8,200 feet in altitude. It is covered with perpetual snow and ice in the form of glaciers.

The climate of this region is controlled by the prevailing westerly winds from the Pacific Ocean and is characterized by great uniformity and by a very heavy rainfall, that at Neah Bay on the northwest coast being probably the heaviest in the United States, with the possible exception of the Alaskan coast. The purpose in making this reserve was not, therefore, the preservation of the water supply, since that is ample, indeed almost excessive in its amount, but the preservation of its forest resources from wasteful destruction.

AGRICULTURAL LAND.

Along the northern edge of the reserve, in Clallam County, there is a narrow strip of comparatively level land, and upon the west side is a large area of equally level or undulating land, extending north and south across the reserve, with a breadth of about three townships eastward from the coast. Nearly all of this, however, is heavily forested. It contains a few prairie openings of trifling amount, having a total area of about 4,000 acres. These prairies may, of course, be classed as agricultural land and, it may be added, have been entirely taken up by settlers. The rest of this large area of land, which is approximately level, is heavily forested.

If this land were cleared of its timber, it should unquestionably be classed as agricultural land, but the expense of clearing it, which ranges from $100 to $200 per acre, seems to take it out of that category, for no farm land in any part of the United States, except in the immediate neighborhood of great cities, where the land could profitably be used for market gardening, is worth any such price. It is true that the cost of clearing the land would be met, in small part, by the value of the timber removed; but this would, in any case, be only a small part of the expense involved. The claim, therefore, that in these heavily forested, well-watered regions the land should be classed as agricultural land appears to be ill-founded. It is true that much of this heavily timbered land has been taken up, and some of it undoubtedly by bona fide settlers, but that the experiment has proved unprofitable is shown by the fact that, although 341 homestead entries have been made within the limits of the reserve in Clallam County, there were in 1899 only 83 residents found there. This appears to furnish incontestable evidence that the experiment of farming under the prevalent conditions in this region has not proved profitable.

FORESTS.

Taken as a whole this is the most heavily forested region of Washington, and, with few exceptions, the most heavily forested region of the country. The densest forests are found in the townships near the Pacific coast, in the northwestern part of the reserve; while in the mountains, as the altitude increases, the forests become less dense and the species become of less value for lumber. The distribution of forests, as regards the stand of timber, is shown upon Pl. LI.

The total stand of timber upon the area examined (2,400 square miles) is 37,100 million feet, an average of 24,000 feet per acre for the entire area. There is no section of equal area in the State so heavily clothed with forests as this.

This is distributed among the different species recognized by lumbermen as follows:

Standing timber in Olympic Reserve, Washington.

	Feet B. M.
Red fir	9,551,750,000
Cedar	3,786,330,000
Hemlock	15,534,750,000
Spruce	2,800,500,000
Silver fir	5,433,500,000

The portion of the reserve lying within Clallam County has been completely examined, with the following results: The total amount of standing timber is 23,822,500,000 feet. This is distributed as follows among the different species recognized by lumbermen:

Standing timber upon portion of Olympic Reserve within Clallam County.

	Feet B. M.
Red fir	5,201,250,000
Cedar	2,440,000,000
Spruce	2,329,750,000
Western white pine	71,750,000
Hemlock	10,630,000,000
Silver fir	3,149,750,000
Total	23,822,500,000

TIMBER TREES.

The principal timber trees of the reserve are as follows:

Red or yellow fir (*Pseudotsuga taxifolia*): This tree grows in abundance. Indeed, it is the principal forest tree throughout the western part of the State of Washington, with the exception of the country immediately bordering on the Pacific Ocean, while it extends up the mountain slopes to an altitude of about 3,500 feet.

White fir (*Abies amabilis*): A tall silvery-barked tree found at considerable elevations, being rarely found below 1,500 feet.

Subalpine fir (*Abies lasiocarpa*): Found only on the higher parts of the mountains and rarely below an elevation of 5,000 feet.

White pine (*Pinus monticola*): This is found on the western slope of the reserve above an elevation of 500 feet, being frequently found in swamps and wet places.

Red cedar (*Thuja plicata*): This tree forms an important component of the forest upon the coast, where it is often seen measuring 50 feet in circumference. Indeed, one tree in the valley of the Elwha measured 84 feet in circumference. It is commonly found growing in low and swampy lands.

Alaska cedar (*Chamæcyparis nootkatensis*): This is found on mountain ridges below 3,500 feet.

Hemlock (*Tsuga mertensiana*): This tree is an almost universal component of the forest up to an altitude of 4,500 feet.

Vine maple (*Acer circinatum*): A small tree, sometimes trailing like a vine, which is common at altitudes below 2,000 feet.

Soft maple (*Acer macrophyllum*): A pretty shade tree which often grows very large. It is found only upon bottom lands and is used for making fine furniture, taking a beautiful finish. It is rarely found at altitudes above 1,500 feet.

Madroña (*Arbutus menziesii*): This species is found along Puget Sound and in the valley of Elwha River. The wood is of a brown color and very tough. It is seldom found more than 12 inches in diameter.

Cottonwood (*Populus trichocarpa*): This is common along streams or on low wet ground, often growing to a diameter of 5 feet. It is of value for paper pulp.

PLANTS AND SHRUBS.

Alder (*Alnus oregona*) is commonly found along streams of lower altitudes. Dogwood (*Cornus nuttallii*), salal, crab apple, bearberry, and rhododendron are also found.

FOREST FIRES.

As will be seen from the map (Pl. LI) considerable tracts of timber land have been burned over, the total area exceeding 48,000 acres, or more than two townships. These burns, as shown on the map, are mainly along the northern border and in the northeastern part of the reserve on waters flowing into the Strait of Juan de Fuca.

The fires east of the Elwha were started about seven years ago from a ranch, and have continued to extend nearly every year. In no case is the fire great enough to burn up the timber completely, but only sufficient to kill the trees and leave them standing. Most of the litter and humus is consumed, and the loss of the humus has seriously retarded reproduction. What reproduction there is in this district is mostly balsam and fir of very inferior quality and of no value whatever for timber, as it branches too close to the ground. Reproduction of yellow fir is practically impossible, since in no instances observed has yellow fir been reproduced after fire. The only two burned areas that have been restocked are those in secs. 2, 3, 4, 8, 9, 10, 11, 12, and 13, T. 30 N., R. 11 W., and in T. 29 N., R. 3 W., where the young growth is balsam and fir. In other burns the old dead timber is standing, with no reproduction whatever except a few small hemlocks here and there. Even the underbrush has not yet commenced to grow.

HUMUS, FOREST LITTER, AND UNDERBRUSH.

The depth of humus is very great along the coast line and adjacent rolling country, but gradually diminishes as the altitude increases, until finally vegetation ceases altogether and the land on the higher ridges is completely bereft of all soil, being washed by the melting snows year after year until nothing is left but the barren rock or rotten shale and slate.

The forest litter is extremely heavy, being made up of the windfalls of centuries—in fact, the most expensive item in clearing land in western Washington is getting rid of the rotten and decayed wood, which never dries, but in clearing has to be continually turned over and burned until it is finally all consumed, after immense trouble and labor.

The forest litter, of course, is much heavier in the burns, where considerable timber is down, and is increased by falling trees and timber. When finally the light penetrates the gloom the underbrush, comprising huckleberry, salmon berry, devil's walking-cane, salal, wild currants, and blackberries, commences to thrive, getting so matted together that it is next to impossible to force one's self through the network of vines.

As the altitude increases the underbrush diminishes, until finally it ceases altogether.

On the lower lands the density of the timber growth has practically nothing to do with the growth of the underbrush, as in numerous places it has been noticed that where a heavy growth of fir and hemlock is standing the brush is extremely dense. The principal requirements for the growth of underbrush are dampness and gloom, as too much sun absorbs the moisture.

LOGGING.

The only logging that has been done within the reserve is in T. 30 N., R. 9 W., along the north boundary, and here only to a very limited extent.

Probably not more than 5 million feet B. M. of fir and cedar have been removed. On Squim Bay, in T. 29 N., R. 3 W., a few logs have been cut immediately along the shore, probably not more than 250,000 feet B. M. of fir and spruce. This comprises all the logging operations so far as seen or heard of.

The reason why logging operations have not been carried on more extensively is that the rivers are too swift and subject to too many freshets, the logs being hung on the numerous bars or washed up into the brush out of the river bed; and then again there are no places to catch and hold the logs if they were driven down the rivers successfully. Especially is this true of the rivers emptying into the ocean.

MINING.

Mining operations are being pushed considerably along the ridge dividing Lillian Creek from Morse Creek, in other words, along the north watershed of the Elwha, but so far nothing that will pay to work has been found. All the mines are prospects; no large amount of work has yet been done on any of them.

Assays show $4 or $5 in gold and copper per ton, but no free-milling ore has yet been discovered. The formation does not warrant the belief that any paying mine will ever be located upon this portion of the reserve. No granite (except a few bowlders), slate, or porphyry has thus far been discovered on the reserve.

GRAZING LANDS.

Large areas of grazing lands are found in the mountainous portions of the reserve, mostly upon the tops of the ridges, between an elevation of 4,000 and 6,000 feet. They are scattered among bunches of timber, but for the most part lie above timber line, as shown by the map (Pl. LI).

The total area of these high mountain pastures is estimated at about 64,000 acres, or the equivalent of nearly three townships.

At present there is no grazing carried on, mainly on account of the difficulty of cutting trails, but it is believed that in the near future grazing will become quite a profitable industry.

ROADS AND TRAILS.

There are numerous roads and trails within the reserve—in fact, all of the surveyed townships have one or more wagon roads and numerous trails. The latter, however, are mostly grown up and hard to find. The principal roads are the following:

From Port Angeles to Piedmont, on Lake Crescent; from Port Angeles, by way of Elwha and Lake Sutherland, to Lake Crescent; from Clallam to La Push, at the mouth of the Hoh River; from Quillayute Prairie to Dickey Lake; and several in T. 29, Rs. 5, 4, and 3.

The traveled trails are as follows: From Dungeness River 6 miles; from the intersection of Indian River and the Elwha up Elwha River to within 4 miles of its head; from Sappho, near Lake Pleasant, to the head of the Soleduck River; from Lake Crescent to intersection with trail on Soleduck; up the North Fork of Kalawa River to intersection with Soleduck trail, crossing through low divide in sec. 11, T. 29 N., R. 12 W.; up the Bogachiel River to sec. 31, T. 28 N., R. 10 W.; up the Hoh River to sec. 36, T. 27 N., R. 11 W.; numerous trails all along and through the coast country and Lake Ozette to West Clallam.

NAVIGATION.

The Indians pole their canoes up nearly all the rivers for a considerable number of miles, trapping and fishing. This is the only way of navigating, as the currents are so swift that it is impossible to row or paddle. Even this form of navigation is practicable only at low water, for when the rivers are in flood it is dangerous to be upon them, not only on account of the swiftness of the current, but because of the presence of driftwood.

RAILROAD CONSTRUCTION AND LOGGING FACILITIES.

There are no railroads in the reserve at present.

The survey for the Port Angeles Eastern, from Port Angeles, Washington, to Olympia, Washington, passes around the head of Squim Bay, in T. 29 N., R. 3 W., and a logging road which starts at Clallam ends at the northeast corner of T. 30 N., R. 9 W., but eventually will be extended to Lake Crescent.

A railroad can be easily constructed from the head of the logging road in T. 30 N., R. 9 W. up Lyre River, around Lake Crescent, and through the low divide at the head of the lake, to the Soleduck, and thence up the Soleduck or down the coast.

Roads can also be easily built up any of the rivers very cheaply, as the country is generally flat for a quarter of a mile or more on either side of them and has very light grades, and, with the exception of two canyons on the Elwha, all of the rivers are free from these obstructions.

Eventually a railroad will be built either from some point on the Strait of Juan de Fuca or from Grays Harbor, thence around the coast, with spurs up the numerous rivers, in order to tap the timber belts.

Taken as a whole, there is very little timber on the west slope of the reserve that can not be easily reached, and when the time comes when that quality of timber is marketable there are very few reserves, if any, that can be logged so easily and thoroughly as the western slope of the Olympic Forest Reserve.

DETAILED DESCRIPTIONS.

TOWNSHIP 21 NORTH, RANGE 5 WEST.

This township, situated in the southeast corner of the reserve, consists mainly of rolling table-lands, rising into mountains along the west line and in the northwest corner. The soil is chiefly clay and loam, and the underbrush is dense. The township is heavily timbered, mainly with red fir, with a little hemlock and cedar, all of good quality.

The timber in the north part of this township can be logged to the South Fork of Skokomish River, up which it will be necessary to build a railroad, as the river is not drivable. In the south part of the township the timber can be logged cheaply by railroad by an extension to existing roads.

Forest conditions in T. 21 N., R. 5 W., Washington.

Timbered area	acres	18, 560
Burned area	do	4, 480
Cut area	feet	72, 000, 000
Total stand of timber	feet B. M.	814, 250, 000
Average stand per acre	feet	43, 900
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 21 N., R. 5 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	742	161	32	36	5	11	177
Cedar	11	98	26	16	2	7	121
Hemlock	61¼	103	18	14	2	4	118

TOWNSHIP 22 NORTH, RANGE 5 WEST.

This township is drained mainly by the South Fork of Skokomish River. East of the river the surface consists of rolling and level bench lands. On the west the country is mountainous and rugged.

The soil is clay, sand, and loam on the bottom lands, while on the upland it consists of clay and gravel. The underbrush is dense. The timber consists chiefly of red fir, with some hemlock and cedar, all of excellent quality.

The timber in this township will have to be logged by two different routes, that in the northern part by a railroad from Lake Cushman through the northeastern part of the township. The south part of the township can be logged into the South Fork of Skokomish River.

Forest conditions in T. 22 N., R. 5 W., Washington.

Timbered area	acres	22,080
Burned area	do	960
Total stand of timber	feet B. M.	768,750,000
Average stand per acre	feet	34,800
Depth of humus	inches	3
Litter		Heavy.

Statistics of forest trees in T. 22 N., R. 5 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	672½	152	24	24	3	6	160
Cedar	23¾	79	11	10	2	6	83
Hemlock	70½	99	11	10	2	4	106
Silver fir	2	148	22	20	3	9	147

TOWNSHIP 23 NORTH, RANGE 5 WEST.

This township, situated in the southeastern part of the reserve, is rugged and mountainous, with the exception of a small area of bottom land above Lake Cushman and on Skokomish River just above the lake. The soil is clay and loam. The underbrush is dense. The timber consists of fir with some hemlock and cedar, all of excellent quality.

The timber in the northern part of this township can all be logged into Lake Cushman very cheaply; that in the southern part of the township should be logged to the South Fork of Skokomish River, which would be somewhat expensive, owing to the ruggedness of the country.

Forest conditions in T. 23 N., R. 5 W., Washington.

Timbered area	acres	19,105
Rugged and barren area	do	640
Burned area	do	2,560
Grazing area	do	735
Total stand of timber	feet B. M.	542,250,000
Average stand per acre	feet	28,400
Depth of humus	inches	3
Litter		Light.

Statistics of forest trees in T. 23 N., R. 5 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	$287\frac{3}{4}$	138	25	21	6	10	160
Cedar	$71\frac{3}{4}$	108	21	16	6	13	133
Hemlock	$116\frac{1}{2}$	98	14	12	5	11	114
Silver fir	$66\frac{1}{4}$	98	15	13	5	14	114

TOWNSHIP 23 NORTH, RANGE 6 WEST.

This township, situated in the southern part of the reserve, is drained by the South Fork of Skokomish River. It is nearly all mountainous and rugged; it contains much snow, even in summer, and considerable areas of rocky and barren country. Its soil is thin, consisting mainly of clay and gravel. Underbrush is dense along the river and creeks, but sparse upon the mountains. The timber consists of red fir, hemlock, silver fir, and cedar, all of excellent quality, except high upon the mountains.

The timber on this township can be logged to the South Fork of Skokomish River, although this is a poor logging stream, with low banks. It will probably be necessary to construct a railroad up its valley for the purpose of carrying out the timber.

Forest conditions in T. 23 N., R. 6 W., Washington.

Timbered area	acres	20, 736
Rocky and barren area	do	1, 664
Burned area	do	192
Grazing area	do	448
Total stand of timber	feet B. M.	383, 500, 000
Average stand per acre	feet	18, 500
Depth of humus	inches	3
Litter		Heavy.

Statistics of forest trees in T. 23 N., R. 6 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	161	158	27	24	7	12	178
Cedar	$42\frac{1}{4}$	103	17	12	7	15	108
Hemlock	$96\frac{1}{4}$	109	14	11	5	16	115
Silver fir	84	106	14	12	5	15	112

Township 24 North, Range 4 West.

This township is in the eastern part of the reserve. With the exception of a little over a section along Hamahama River, it is practically all rugged and mountainous. The soil is clay and loam in the bottom lands of the river and gravel on the mountain ranges. The underbrush is dense except on the ridges, and the timber consists of fir and hemlock, with some cedar and a little silver fir. It is all tributary to Hamahama River, but as this stream is of no value for logging purposes and as there is not sufficient water for driving anything larger than shingle bolts, it will be necessary to build a railroad from Hood Canal up the valley of the river across the township.

Forest conditions in T. 24 N., R. 4 W., Washington.

Timbered area	acres	17, 240
Rocky and barren area	do	3, 520
Burned area	do	1, 600
Grass-land area	do	360
Total stand of timber	feet B. M.	566, 750, 000
Average stand per acre	feet	32, 900
Depth of humus	inches	3
Litter		Heavy.

Statistics of forest trees in T. 24 N., R. 4 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	306¼	134	22	19	2	6	144
Cedar	62½	97	16	12	2	9	112
Hemlock	167	114	14	12	2	4	123
Silver fir	31	117	14	12	2	4	122

Township 24 North, Range 5 West.

This township, drained by Skokomish River and its North Fork, is very rugged and mountainous, with the exception of the narrow valleys of the streams. The soil is gravelly and rocky. The underbrush is mainly light. The timber consists of red fir, hemlock, cedar, and silver fir, all of which is of good quality, except high upon the mountains.

Most of the timber in this township can be logged to the North Fork of Skokomish River, with the exception of a small area in the eastern part, which is in the drainage basin of Hamahama River. The North Fork of the Skokomish is a poor logging stream, since it flows through a deep canyon with rock walls and has a steep slope.

Forest conditions in T. 24 N., R. 5 W., Washington.

Timbered area	acres	17,600
Rocky and barren area	do	1,600
Burned area	do	640
Mountain meadows	do	3,200
Total stand of timber	feet B. M.	485,500,000
Average stand per acre	feet	27,600
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 24 N., R. 5 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	137¼	176	28	20	8	12	178
Cedar	76½	85	16	11	5	10	98
Hemlock	140¾	116	17	12	9	20	126
Spruce	1¾	193	26	24	2	4	180
Silver fir	129¼	126	18	14	8	20	132

TOWNSHIP 24 NORTH, RANGE 6 WEST.

This township is mountainous, with the exception of a small tract along Camp Six Stream. The soil is mainly clay and coarse gravel. Underbrush is chiefly light, except in the valleys of the creeks. The timber consists of silver fir, hemlock, red fir, and cedar. The timber can be logged eastward to the North Fork of Skokomish River.

Forest conditions in T. 24 N., R. 6 W., Washington.

Timbered area	acres	17,920
Rocky and barren area	do	640
Mountain meadows	do	4,480
Total stand of timber	feet B. M.	359,000,000
Average stand per acre	feet	20,000
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 24 N., R. 6 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	59¼	145	24	21	8	16	153
Cedar	55¾	73	16	11	6	13	105
Hemlock	113½	93	15	11	7	18	110
Spruce	6¼	170	25	25	1	2	165
Silver fir	124½	93	14	12	6	17	111

TOWNSHIP 25 NORTH, RANGE 3 WEST.

This township is mountainous except some small tracts of bottom land along the Duckabush River. The soil is clay, loam, and gravel. The underbrush is dense except on the ridges. The timber consists mainly of red fir, with some hemlock and cedar, and the fir is of excellent quality.

This township will be very difficult to log because of the ruggedness of the country. In the southern part it can be logged southward into the Hamahama River, while the eastern part of the township can be logged down Fulton Creek by tramway or skid road. The northern part can be logged into Duckabush River.

Forest conditions in T. 25 N., R. 3 W., Washington.

Timbered area	acres	22, 400
Rocky and barren area	do	640
Total stand of timber	feet B. M.	604, 000, 000
Average stand per acre	feet	27, 000
Depth of humus	inches	3
Litter		Heavy.

Statistics of forest trees in T. 25 N., R. 3 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	458¼	157	31	31	2	6	173
Cedar	34¾	73	11	9	3	5	89
Hemlock	102½	94	13	12	2	4	110
Silver fir	8½	92	14	14	2	5	117

TOWNSHIP 25 NORTH, RANGE 4 WEST.

This township, which is traversed by the Duckabush River from west to east, is mountainous and rugged, with the exception of about 1,000 acres of bottom land along the river. The soil on the upland is clay and coarse gravel, with clay and loam on the bottom land. The underbrush is dense on the bottom land, becoming sparser on the ridges. The timber consists of red and silver fir and hemlock, with a little cedar.

The timber in this township is mainly in the northern part and can be logged into Duckabush River, and the little which stands in the southern part of the township can be taken to Hamahama River.

Forest conditions in T. 25 N., R. 4 W., Washington.

Timbered area	acres	18, 176
Rocky and barren area	do	1, 920
Burned area	do	64
Mountain meadows	do	2, 880

Total stand of timber	feet B. M.	340, 000, 000
Average stand per acre	feet	18, 700
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 25 N., R. 4 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	171	154	31	32	3	7	173
Cedar	6½	74	12	10	3	7	90
Hemlock	91	96	15	13	3	7	115
Silver fir	71½	99	14	13	3	7	118

TOWNSHIP 25 NORTH, RANGE 5 WEST.

This township is drained mainly by Duckabush River, which flows across it from west to east. Its surface is mainly mountainous and very rugged. Its soil is clay and gravel, and the underbrush is light. The timber consists chiefly of hemlock and silver and red fir, with a little cedar.

The timber in this township is principally in the northern part, and can be logged to the Duckabush River. This stream, however, is of no value for driving purposes, and it will be necessary to build a tramroad up its valley to get the timber out.

Forest conditions in T. 25 N., R. 5 W., Washington.

Timbered area	acres	12, 480
Rocky and barren area	do	5, 760
Mountain meadows	do	4, 800
Total stand of timber	feet B. M.	206, 000, 000
Average stand per acre	feet	16, 500
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 25 N., R. 5 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	30¾	152	27	19	5	9	157
Cedar	16⅓	52	10	8	5	16	78
Hemlock	72	90	16	12	8	30	116
Spruce	½	160	24	24	2	4	160
Silver fir	86½	108	17	13	9	42	119

Township 26 North, Range 3 West.

This township is drained mainly by Dusewallips River, which flows across it from east to west. Its surface, with the exception of small areas of bottom land along the river, is mountainous and rugged. The soil is very stony and gravelly. Underbrush is sparse. The timber consists of red fir and hemlock, with a little silver fir and a trifling amount of cedar. It is all of good quality, except on the high divides, where it is small and stunted.

The timber in this township, with the exception of a few sections along the north line, which can be logged to the Quilcene River, will go to Dusewallips River. This, however, is a poor logging stream, and it will be necessary to build a railroad or tramways along the river to get the lumber out.

Forest conditions in T. 26 N., R. 3 W., Washington.

Timbered area	acres	12,400
Rocky and barren area	do	5,760
Burned area	do	1,680
Mountain meadows	do	640
Total stand of timber	feet B. M.	606,000,000
Average stand per acre	feet	48,900
Depth of humus	inches	3
Litter		Light.

Statistics of forest trees in T. 26 N., R. 3 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	332	162	27	41	7	3	186
Cedar	11	112	23	21	6	17	189
Hemlock	225	124	15	22	7	6	118
Silver fir	38	130	15	35	18	8	152

Township 26 North, Range 4 West.

This township is drained almost entirely by the Dusewallips River, which flows across it from the northwest to the southeast. Its surface is mountainous and rugged, its soil clay and gravel, and the underbrush is sparse. The timber consists of hemlock and silver and red fir, with a little cedar, all of good quality, excepting on the high ridges, where the timber becomes small and stunted.

The timber can nearly all be logged to Dusewallips River, but, as this is a poor logging stream, it will be necessary to build a railroad or tramways up its valley, and, moreover, owing to the steepness of the slopes, it will be necessary to bring the timber down in flumes from the ridges.

Forest conditions in T. 26 N., R. 4 W., Washington.

Timbered area	acres	16,960
Rocky and barren area	do	2,560
Mountain meadows	do	3,520
Total stand of timber	feet B. M.	516,000,000
Average stand per acre	feet	30,424
Depth of humus	inches	2
Litter		Medium.

Statistics of forest trees in T. 26 N., R. 4. W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	119	108	25	24	3	5	153
Cedar	13½	72	19	27	6	19	133
Hemlock	186	72	15	15	4	9	120
Silver fir	197½	84	17	17	4	13	127

TOWNSHIP 26 NORTH, RANGE 5 WEST.

This township contains the high divide at the heads of branches of the Dusewallips, Elwha, and Queniult rivers, and is mountainous and rugged, with very little soil and light underbrush. It contains but little timber, consisting mainly of silver and red fir and hemlock. The timber can be logged down the branches of the Dusewallips, Queniult, and Elwha rivers, but as these streams are very rapid the timber will have to be handled by chutes and flumes.

Forest conditions in T. 26 N., R. 5 W., Washington.

Timbered area	acres	19,840
Rocky and barren area	do	1,600
Mountain meadows	do	1,600
Total stand of timber	feet B. M.	101,750,000
Average stand per acre	feet	5,128
Litter		Light.

Statistics of forest trees in T. 26 N., R. 5 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	15½	111	23	20	3	6	133
Cedar	3¼	67	15	11	8	25	118
Hemlock	38	74	15	11	5	25	120
Silver fir	45	80	17	13	4	27	124

Township 26 North, Range 6 West.

This township is drained almost entirely by Elwha River, and its surface is mountainous and rugged, with the exception of the narrow valley of the river. The soil is very thin and stony. The underbrush is light. The timber consists chiefly of hemlock and silver and red fir, and is of poor quality, excepting in the narrow valley of the Elwha.

The timber can be logged mainly to Elwha River, although this is of no value as a logging stream, as it has low banks and not sufficient water for driving. Still, along its banks tramways or logging roads can be built.

Forest conditions in T. 26 N., R. 6 W., Washington.

Timbered area	acres	23, 040
Total stand of timber	feet B. M.	296, 000, 000
Average stand per acre	feet	12, 800
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 26 N., R. 6 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	64	144	31	36	3	6	172
Cedar	5	80	20	18	6	20	130
Hemlock	101	84	17	15	4	26	125
Silver fir	126	92	18	17	4	28	127

Township 26 North, Range 7 West.

This township, which is drained mainly by Elwha River, is rugged and mountainous, with the exception of a narrow strip of valley land along the Elwha. The soil is a clay in the Elwha Valley, but the uplands are rocky and gravelly. The underbrush is very dense except in the higher country, where it becomes sparse. The timber consists of red fir, hemlock, and silver fir. The fir, which occurs chiefly in the river valley, is of good quality. Elsewhere the timber is poor.

Nearly all of the valuable timber in this township is in the immediate valley of Elwha River, and as this stream is not drivable it will be necessary to build a railroad or tramway up the valley in order to reach it.

Forest conditions in T. 26 N., R. 7 W., Washington.

Timbered area	acres	17,280
Rocky and barren area	do	2,880
Mountain meadows	do	2,880
Total stand of timber	feet B. M.	177,250,000
Average stand per acre	feet	10,300
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 26 N., R. 7 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	19½	136	32	31	2	7	174
Hemlock	61¾	79	17	13	4	26	127
Silver fir	96	87	18	15	4	36	131

TOWNSHIP 26 NORTH, RANGE 12 WEST.

The eastern part of this township is mountainous and rugged; the western is gently sloping and rolling, with many cedar swamps. The soil is clay and loam along the river and in the swamps, while the upland has a red clay, gravelly soil. The underbrush is dense, except on the uplands, where it becomes sparse. The timber is mainly hemlock, with some cedar, silver fir, and a little spruce. There is no red fir in the township. Hemlock, spruce, and silver fir are of good quality, but the cedar is poor.

Most of the timber in this township can be logged to Hoh River, which is a good logging stream at all seasons. The western part of the township can be logged cheaply; the eastern part will be quite expensive to handle on account of the ruggedness of the surface.

Forest conditions in T. 26 N., R. 12 W., Washington.

Timbered area	acres	23,040
Total stand of timber	feet B. M.	682,500,000
Average stand per acre	feet	29,600
Humus		Light.
Litter		Heavy.

Statistics of forest trees in T. 26 N., R. 12 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Cedar	106½	118	43	24	10	32	194
Hemlock	429	133	17	25	5	9	140
Spruce	42¼	195½	54	53	3	5	198
Silver fir	104¾	162	22½	39	3½	5	157

TOWNSHIP 26 NORTH, RANGE 13 WEST.

This township lies along the Pacific Ocean, the coast line traversing in part the western tier of sections. It is mainly in the drainage basin of Hoh River. The surface is steeply rolling on the north, with level bottom land all along Hoh River. The southern part of the township, like the northern part, is rolling. The soil is clay and sandy loam. The underbrush is dense. The timber consists of hemlock and cedar, with some spruce and a little silver fir. The spruce stands heavily along Hoh River and is very large. The silver fir is of good quality, while the cedar and hemlock are poor.

With the exception of a few sections on the north of the township the timber can be logged to Hoh River, which is a good driving stream. Logging will be very cheap, excepting in the northern part of the township. As there is no harbor at the mouth of the river it will be necessary to saw the lumber at or near the coast and take it out by railroad.

Forest conditions in T. 26 N., R. 13 W., Washington.

Timbered area	acres	21,440
Total stand of timber	feet B. M.	697,000,000
Average stand per acre	feet	32,500
Depth of humus	inches	4
Litter		Medium.

Statistics of forest trees in T. 26 N., R. 13 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Cedar	197½	100	49	24	9	42	223
Hemlock	372	124	21	23	4	7	153
Spruce	91½	175	50	47	2	4	171
Silver fir	36	162	31	38	2	4	160

TOWNSHIP 26 NORTH, RANGE 14 WEST.

This is a fractional township lying on the Pacific Ocean, comprising only about four sections. Its surface is steeply rolling, with a rocky bluff along the coast. The soil is red clay. The underbrush is dense. The timber consists of hemlock, cedar, and spruce. The last is of good quality, but the other species are of little value.

Forest conditions in T. 26 N., R. 14 W., Washington.

Timbered area	acres	2,560
Total stand of timber	feet B. M.	93,000,000
Average stand per acre	feet	36,300

Statistics of forest trees in T. 26 N., R. 14 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir							226
Cedar	21	110	58	27	9	40	226
Hemlock	60	124	19	21	5	9	150
Spruce	12	180	53	50	2	5	182

TOWNSHIP 27 NORTH, RANGE 3 WEST.

This township is composed entirely of mountainous and rugged country. Quilcene River, which traverses it, has a narrow valley. The soil is very stony. The underbrush is dense along the streams, but light along the ridges. The timber consists of hemlock and red fir, with a little silver fir. It is of good quality, excepting on the high divides, where it becomes small and knotty. Along Quilcene River red fir is very heavy.

Forest conditions in T. 27 N., R. 3 W., Washington.

Timbered area	acres	16,000
Rocky and barren area	do	1,280
Burned area	do	2,445
Mountain meadows	do	2,880
Total stand of timber	feet B. M.	511,500,000
Average stand per acre	feet	32,000
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 27 N., R. 3 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	167½	174	33	44	16	9	200
Cedar	8	95	26	17	16	24	184
Hemlock	240¾	119	18	19	14	11	124
Silver fir	95¼	112	18	20	14	25	122

TOWNSHIP 27 NORTH, RANGE 4 WEST.

The surface of this township is rugged and mountainous. It is drained mainly toward the northeast by Dungeness River. The southwest corner is drained by the Dusewallips River. The soil is chiefly a clay derived from the underlying slates. The underbrush is dense along the rivers and light on the ridges. The timber, which is very light, consists of silver fir and hemlock of little value.

Forest conditions in T. 27 N., R. 4 W., Washington.

Timbered area	acres	11,200
Rocky and barren area	do	5,440
Mountain meadows	do	7,040
Total stand of timber	feet B. M.	33,500,000
Average stand per acre	feet	2,991
Litter		Light.

Statistics of forest trees in T. 27 N., R. 4 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	1½	120	20	20	2	8	140
Hemlock	12¾	72	16	12	2	21	124
Silver fir	19¼	79	17	13	2	25	128

TOWNSHIP 27 NORTH, RANGE 5 WEST.

This township is mountainous throughout. It has little soil, and what little there is is very stony. The underbrush is light. It contains little timber, consisting of silver fir and hemlock of poor quality.

Forest conditions in T. 27 N., R. 5 W., Washington.

Timbered area	acres	2,560
Rocky and barren area	do	5,760
Burned area	do	7,040
Mountain meadows	do	7,680
Total stand of timber	feet B. M.	35,750,000
Average stand per acre	feet	14,000
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 27 N., R. 5 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	1½	95	19	18	2	7	135
Hemlock	14¼	72	16	11	3	22	124
Silver fir	20	80	17	13	4	26	126

TOWNSHIP 27 NORTH, RANGE 6 WEST.

With the exception of a narrow strip of bench land along Elwha River, the surface of this township is mountainous. The soil is clay and gravel. The underbrush is dense in the Elwha Valley, but light upon the ridges. The timber consists of red and silver fir and hemlock. The red fir is of good quality, but the other species are of little value. The timber in this township can be logged most economically to Elwha River, although this is a poor logging stream, and it will be necessary to build a railroad or tramway up its valley.

Forest conditions in T. 27 N., R. 6 W., Washington.

Timbered area	acres..	18, 880
Rocky and barren area	do...	1, 280
Burned area	do...	1, 280
Mountain meadows	do...	1, 600
Total stand of timber	feet B. M..	425, 000, 000
Average stand per acre	feet..	22, 500
Depth of humus	inches..	2
Litter		Medium.

Statistics of forest trees in T. 27 N., R. 6 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	155½	176	29	37	3	5	207
Hemlock	146	91	18	17	5	12	122
Silver fir	123½	88	17	18	5	12	120

TOWNSHIP 27 NORTH, RANGE 7 WEST.

This township is mountainous throughout, with very thin scanty soil and light underbrush. The timber, which is scanty, consists mainly of silver fir and hemlock, with a little red fir, all of poor quality.

Forest conditions in T. 27 N., R. 7 W., Washington.

Timbered area	acres..	14, 720
Rocky and barren area	do...	5, 440
Mountain meadows	do...	2, 880
Total stand of timber	feet B. M..	49, 250
Average stand of timber	feet..	3, 345
Depth of humus	inches..	2
Litter		Light.

Statistics of forest trees in T. 27 N., R. 7 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	8	98	18	16	2	7	132
Hemlock	17	72	15	11	3	23	125
Silver fir	24¼	80	17	13	3	25	123

Township 27 North, Range 8 West.

This township is drained mainly by Hoh River, toward the north. Its surface is mountainous and rugged, with the exception of the valley of Hoh River. The mountainous country contains much snow and many glaciers. The soil is clay and in the upper country rocky. Underbrush is dense along the river, but sparser on the upland. The timber is mainly hemlock, silver fir, and red fir, all of poor quality, being small and scrubby.

The timber in this township can be logged to Hoh River, although this is of no value as a logging stream, being very rapid, with many deep canyons. Flumes can, however, be built for its transportation.

Forest conditions in T. 27 N., R. 8 W., Washington.

Timbered area	acres	6,080
Rocky area	do	13,440
Mountain meadows	do	3,520
Total stand of timber	feet B. M.	67,000,000
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 27 N., R. 8 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	25	110	25	18	2	5	155
Hemlock	18¾	75	16	12	4	16	127
Silver fir	23¼	79	17	13	4	20	131

Township 27 North, Range 10 West.

This township is drained mainly by Hoh River. Its surface is steep and mountainous, with the exception of a tract of bench land at the forks of Hoh River. The soil is clay and gravel and the underbrush is dense. The timber consists mainly of hemlock, red fir, and silver fir, with a little spruce and a trifling amount of cedar. The fir and spruce are of excellent quality. The hemlock and silver fir are of little value, being very scrubby, especially on the divides.

The timber in this township, with the exception of a small tract along the north line, can be logged to Hoh River, which here is a poor logging stream with low banks and many sand bars. A railroad can, however, be extended up Hoh River with easy grades and thus serve as an outlet.

Forest conditions in T. 27 N., R. 10 W., Washington.

Timbered area	acres	23, 040
Total stand of timber	feet B. M.	994, 250, 000
Average stand per acre	feet	43, 200
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 27 N., R. 10 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	295	186	48	51	1	3	242
Cedar	6¾	100	20	16	4	14	200
Hemlock	386	122	19	20	1	3	126
Spruce	60½	202	55	41	1	3	220
Silver fir	246	108	16	24	1	3	129

TOWNSHIP 27 NORTH, RANGE 11 WEST.

This township slopes on the north to the valley of the Bogachiel and on the south to that of Hoh River. Its surface is steeply rolling and broken, with some bottom land along Hoh River. The soil is clay, gravel, and loam. The underbrush is dense. The timber, consisting of hemlock, silver fir, and red fir, with a little cedar and spruce, is of excellent quality, excepting the cedar, which is small. That on the southern part of the township can be logged to Hoh River, a good driving stream. The northern part should go to the valley of the Bogachiel. This stream is of no value for driving and the lumber will have to be taken out by rail.

Forest conditions in T. 27 N., R. 11 W., Washington.

Timbered area	acres	23, 040
Total stand of timber	feet B. M.	843, 000, 000
Average stand per acre	feet	36, 200
Depth of humus	inches	3
Litter		Light.

Statistics of forest trees in T. 27 N., R. 11 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	134	187	52	56	2	4	230
Cedar	36½	121	43	23	4	21	231
Hemlock	383	119	16	22	3	5	138
Spruce	64¼	200	65	40	2	4	213
Silver fir	225¼	108	15	25	2	4	127

Township 27 North, Range 12 West.

The northern part of this township is drained by Bogachiel River and the southern part by Hoh River. The surface is steeply rolling, with bottom land along the rivers. The soil is clay and loam, and the underbrush is dense. The timber, all of good quality, consists chiefly of hemlock, cedar, and silver fir, with a little spruce and red fir intermixed. The fir and spruce in the immediate valleys of the rivers are exceptionally large and fine.

The timber in the southern part of this township can be logged to Hoh River, which is a good driving stream. That in the northern part can be logged to the valley of the Bogachiel, but will have to be taken out by rail, as the stream is not drivable.

Forest conditions in T. 27 N., R. 12 W., Washington.

Timbered area	acres	23, 040
Total stand of timber	feet B. M.	738, 000, 000
Average stand per acre	feet	32, 031
Depth of humus	inches	3
Litter		Heavy.

Statistics of forest trees in T. 27 N., R. 12 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Deceased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	32	209	48	57	5	4	227
Cedar	146½	121	49	29	7	31	239
Hemlock	413	138	16	28	4	4	141
Spruce	37½	193	56	51	8	4	218
Silver fir	109	162	25	36	4	4	140

Township 27 North, Range 13 West.

The surface of this township is rolling and broken, comprising an alternation of steep ridges and deep valleys. The soil is loam and clay. The underbrush is dense. The timber consists of hemlock, cedar, and silver fir, with a little spruce. The cedar is of poor quality. The other species are excellent.

With the exception of a small area in the northeast corner, which can be logged into Bogachiel River, the timber on this township should be logged westward down the valleys of the creeks toward the coast, but as there is no harbor on this coast it will be necessary to build a railroad from some inland point to carry out the timber or the sawed lumber.

Forest conditions in T. 27 N., R. 13 W., Washington.

Timbered area	acres	23,040
Total stand of timber	feet B. M.	1,015,500,000
Average stand per acre	feet	44,100
Depth of humus	inches	3
Litter		Heavy.

Statistics of forest trees in T. 27 N., R. 13 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Cedar	306	109	52	24	7	43	222
Hemlock	493	131	21	24	5	8	150
Spruce	65	175	46	48	3	5	175
Silver fir	151½	158	33	40	3	15	160

TOWNSHIP 27 NORTH, RANGE 14 WEST.

This township lies in the western part of the reserve on the Pacific coast and comprises the equivalent of 24½ sections. Its surface is rolling and broken, with a bluff, rocky coast. Its soil is clay and loam. The underbrush is dense. The timber is chiefly hemlock, with some spruce and cedar. The spruce is large and excellent, but the other species are second class. Owing to the rocky character of the coast and the absence of any harbor, it will be necessary to ship this timber by railroad from some point in the interior.

Forest conditions in T. 27 N., R. 14 W., Washington.

Timbered area	acres	15,680
Total stand of timber	feet B. M.	634,750,000
Average stand per acre	feet	40,500
Depth of humus	inches	3
Litter		Heavy.

Statistics of forest trees in T. 27 N., R. 14 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Cedar	83	145	53	28	8	22	205
Hemlock	464	134	21	23	5	8	148
Spruce	87¾	191	51	53	2	4	187

TOWNSHIP 27 NORTH, RANGE 15 WEST.

This is a fractional township, lying on the north Pacific coast, comprising less than a square mile.

Forest conditions in T. 27 N., R. 15 W., Washington.

Timbered area	acres	600
Total stand of timber	feet B. M.	13,250,000
Average stand per acre	feet	22,083

Statistics of forest trees in T. 27 N., R. 15 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Cedar	$\frac{3}{4}$	100	44	22	8	40	200
Hemlock	12	125	20	22	6	10	140
Spruce	1	175	44	40	4	6	177½

TOWNSHIP 28 NORTH, RANGE 3 WEST.

This township is situated on the eastern border of the reserve. It is drained in part by the Dungeness River and in part by the Little Quilcene. Its surface is mountainous and rugged. The soil is clayey and sandy, being derived from underlying slates and sandstones. The underbrush is scanty. This township is well timbered with a good quality of fir, hemlock, and silver fir, with a little cedar. The timber from the eastern part of it can be logged to Quilcene River by means of skid roads; that from the western part to the Dungeness River in a similar manner.

Forest conditions in T. 28 N., R. 3 W., Washington.

Timbered area	acres	14,272
Rocky and broken area	do	640
Burned area	do	7,488
Mountain meadows	do	640
Total stand of timber	feet B. M.	641,250,000
Average stand per acre	feet	44,900
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 28 N., R. 3 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	155	179	30	44	14	8	198
Cedar	32¼	128	25	27	32	22	151
Hemlock	266	143	20	24	28	15	122
Silver fir	188	137	21	29	34	19	125

TOWNSHIP 28 NORTH, RANGE 4 WEST.

This township is situated in the eastern part of the reserve and is drained by the Dungeness River. The surface of the township is mountainous and rugged. The soil is clay and sand, being derived from underlying slates and sandstones. The underbrush is scanty. The township is sparsely timbered with hemlock and silver fir. The timber in the township can be logged to the Dungeness River by means of skid roads.

Forest conditions in T. 28 N., R. 4 W., Washington.

Timbered area	acres	13,120
Rocky and broken area	do	3,840
Burned area	do	3,200
Mountain meadows	do	2,880
Total stand of timber	feet B. M.	50,500,000
Average stand per acre	feet	4,000
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 28 N., R. 4 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Hemlock	19	60	16	11	7	28	101
Silver fir	31½	63	16	14	7	26	103

TOWNSHIP 28 NORTH, RANGE 5 WEST.

This township, situated in the eastern part of the reserve, is drained by Dungeness River and its branches. Its surface is entirely mountainous and broken. Its soil is derived from sandstones and slates. Underbrush is light. The timber consists of a scrubby growth of hemlock and silver fir, much of which on the east side of the township has been burned. The timber can be logged to the valleys of the branches of Dungeness River, up which skid roads or tramways may be built.

Forest conditions in T. 28 N., R. 5 W., Washington.

Timbered area	acres	17,000
Rocky area	do	1,920
Burned area	do	640
Mountain pastures	do	4,480
Total stand of timber	feet B. M.	83,500,000
Average stand per acre	feet	4,900
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 28 N., R. 5 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Hemlock	30	62	16	11	5	30	111
Silver fir	53½	69	18	14	4	28	118

TOWNSHIP 28 NORTH, RANGE 6 WEST.

This township, situated in the eastern part of the reserve, is mainly composed of high mountains drained by Elwha River and its branch, Lillian Creek. The soil is chiefly clay derived from underlying slates. The underbrush is light and along the Elwha River has been mainly burned away. Over large areas the timber as well as the underbrush has been destroyed by fire. The timber consists of fir, hemlock, and silver fir, nearly all of poor quality.

This timber can in the main be logged to the valley of Elwha River, but as that river and its branch, Lillian Creek, are of no value for driving purposes, it will be necessary to handle the timber with chutes or flumes; consequently, it will be expensive to log this township.

Forest conditions in T. 28 N., R. 6 W., Washington.

Timbered area	acres	13, 120
Rocky area	do	960
Burned area	do	480
Mountain meadows	do	4, 480
Total stand of timber	feet B. M.	143, 000, 000
Average stand per acre	feet	10, 900
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 28 N., R. 6 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	49	128	26	28	5	6	150
Hemlock	52	65	17	14	7	16	103
Silver fir	42	64	17	15	7	16	105

TOWNSHIP 28 NORTH, RANGE 7 WEST.

This township is drained by Elwha River and Cat Creek. Its surface is throughout mountainous. Its soil is clay and gravel. Underbrush is light. The timber, which is very light, consists of hemlock, fir, and silver fir, all of poor quality, having to a large extent been destroyed by fire.

A. VIEW OF HEAD OF LILLIAN CREEK; ELEVATION 5,700 FEET.

B. FALLS ON CREEK AT HEAD OF SOLEDUCK RIVER.

The timber can be logged to Elwha River, although that is a poor logging stream, with low banks and many canyons and gravel bars. It is probable that flumes would have to be constructed along the river to carry the timber out.

Forest conditions in T. 28 N., R. 7 W., Washington.

Timbered area	acres	16,000
Barren area	do	1,280
Burned area	do	3,840
Mountain meadows	do	1,920
Total stand of timber	feet B. M.	171,500,000
Average stand per acre	feet	10,700
Humus	inches	2
Litter		Medium.

Statistics of forest trees in T. 28 N., R. 7 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	59½	159	29	22	13	6	185
Hemlock	71	113	17	16	13	8	124
Silver fir	47	108	18	15	10	9	121

TOWNSHIP 28 NORTH, RANGE 8 WEST.

This township is all rugged and mountainous. It is drained on the south by Hoh River, on the north by Cat Creek and the Soleduck, whose headwaters it includes. The soil is mainly coarse and gravelly. Underbrush is dense along the rivers while on the uplands it is light, the high divides consisting of open grass land. The timber is chiefly fir, with some hemlock and silver fir, and a few scattering cedars. It is in the main of poor quality.

The timber in the southern part of this township can be logged to Hoh River; on the east it can be sent down Cat Creek to the Elwha, and on the west to the Soleduck, but owing to the mountainous character of the township logging will be extremely expensive.

Forest conditions in T. 28 N., R. 8 W., Washington.

Timbered area	acres	17,920
Rocky area	do	1,920
Grazing area	do	3,200
Burned area	do	128
Total stand of timber	feet B. M.	207,750,000
Average stand per acre	feet	11,600
Humus	inches	2
Litter		Medium.

Statistics of forest trees in T. 28 N., R. 8 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	112	157	32	38	3	4	198
Cedar	4	51	18	14	7	29	104
Hemlock	53¼	68	16	13	5	38	106
Silver fir	38½	63	17	14	5	39	102

TOWNSHIP 28 NORTH, RANGE 9 WEST.

This township is drained by the Soleduck, Hoh, and Bogachiel rivers. Most of it lies very high and it is all mountainous and broken. The soil is stony. Underbrush is scanty on the uplands, but dense in the narrow river valleys.

The timber consists mainly of hemlock and silver fir, with a trifling amount of red fir. The latter is of good quality, but the hemlock and silver fir are scrubby and of no value.

The timber can be logged to the rivers by which the township is drained. They are, however, poor logging streams and it is not probable that the small amount of timber in the township will ever tempt lumbermen to bring a railroad into it.

Forest conditions in T. 28 N., R. 9 W., Washington.

Timbered area	acres	22, 720
Rocky area	do	128
Burned area	do	192
Total stand of timber	feet B. M.	266, 750, 000
Average stand per acre	feet	11, 700
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 28 N., R. 9 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	18	84	24	19	2	9	133
Cedar	1	45	13	8	3	40	100
Hemlock	137¾	66	19	15	4	12	103
Silver fir	110	68	17	14	5	15	105

TOWNSHIP 28 NORTH, RANGE 10 WEST.

This township is drained by Bogachiel River and the South Fork of the Kalawa. It is nearly all a mountainous region, sloping to the westward, and with narrow valleys along the rivers. The soil is clay and gravel. The underbrush is dense in the valleys but sparse upon the ridges. The timber is mainly hemlock and silver fir, most of it being of good quality. There is a little red fir also, of fine quality.

This township, with the exception of a small tract in the northwest corner which can be logged to Kalawa River, can be logged to the Bogachiel, although this is a poor logging stream, with low banks and not sufficient water for driving. The valley, however, furnishes an excellent route for a railroad, which will probably be the method employed for clearing the township.

Forest conditions in T. 28 N., R. 10 W., Washington.

Timbered area	acres	23, 040
Total stand of timber	feet B. M.	539, 500, 000
Average stand per acre	feet	23, 400
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 28 N., R. 10 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	40½	104	21	20	3	4	133
Hemlock	262	113	19	15	3	5	126
Spruce	7	129	36	26	3	5	144
Silver fir	230	115	19	14	3	5	127

TOWNSHIP 28 NORTH, RANGE 11 WEST.

This township is drained to the westward by the Bogachiel and Kalawa rivers. It consists of mountainous spurs running nearly east and west, with narrow valleys along the streams. The soil is red clay in the upland and loam along the rivers. The underbrush is dense in the valleys and sparse upon the ridges. The timber consists mainly of hemlock, red and silver fir, with a little spruce and cedar.

The timber can be logged to the Bogachiel and Kalawa rivers, but as they are poor driving streams it is probable that it will be necessary to construct railroads to get the lumber out. It will be an expensive township to log on account of the steepness and ruggedness of the ridges.

Forest conditions in T. 28 N., R. 11 W., Washington.

Timbered area	acres	23, 040
Total stand of timber	feet B. M.	812, 500, 000
Average stand per acre	feet	35, 300
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 28 N., R. 11 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	140	177	37	35	2	3	203
Cedar	10½	100	38	21	5	17	206
Hemlock	428	126	21	22	2	3	132
Spruce	27	175	44	30	2	5	190
Silver fir	206	144	28	34	2	3	150

TOWNSHIP 28 NORTH, RANGE 12 WEST.

This township is drained by the Kalawa and Bogachiel rivers, and consists almost entirely of rugged mountain ridges. The soil is mainly clay. The underbrush, as everywhere else, is dense in the valleys and sparse upon the ridges. The timber is chiefly hemlock and silver fir, with some red fir, spruce, and cedar scattered through it. The stand is extremely heavy and the timber of all kinds is of good quality.

The timber may be logged to the rivers, but as they are poor driving streams it is probable that it will be found necessary to build railroads up their valleys for the purpose of getting the lumber out.

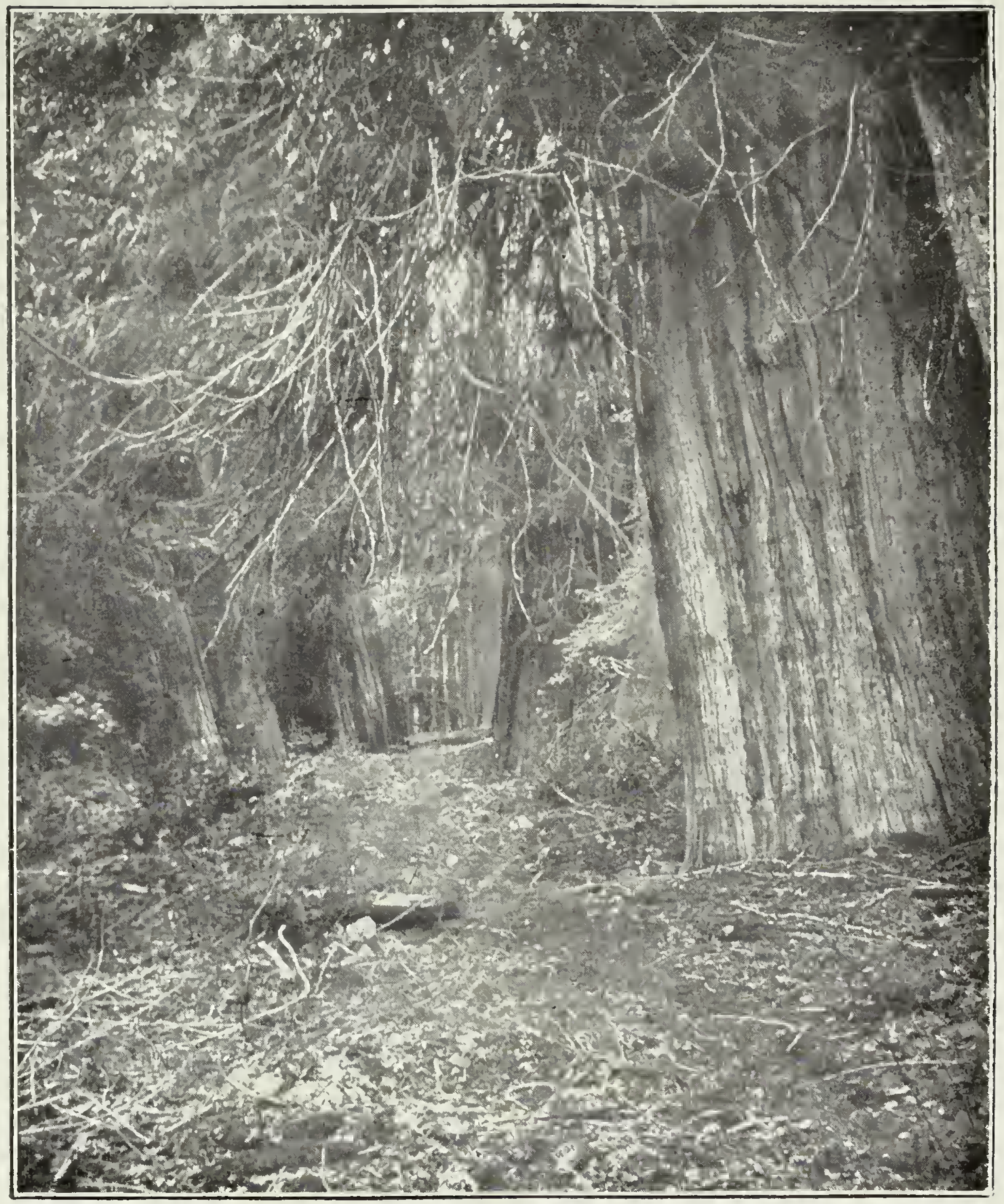
Forest conditions in T. 28 N., R. 12 W., Washington.

Timbered area	acres	23, 040
Total stand of timber	feet B. M.	1, 050, 500, 000
Average stand per acre	feet	45, 600
Depth of humus	inches	3
Litter		Medium.

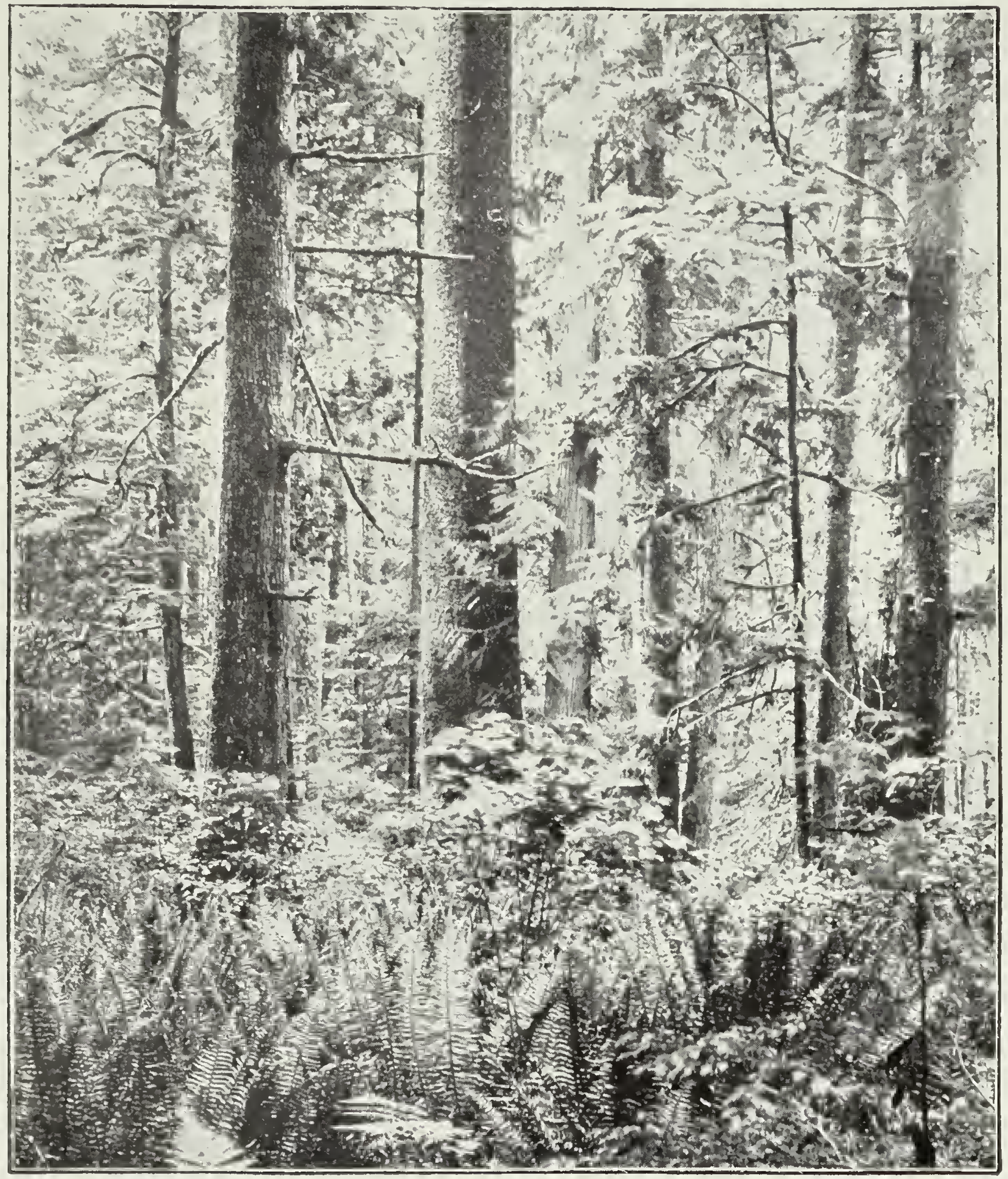
Statistics of forest trees in T. 28 N., R. 12 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	98	199	40	49	3	5	229
Cedar	27	128	45	26	6	15	209
Hemlock	555	141	24	34	2	4	151
Spruce	43½	215	56	56	2	4	213
Silver fir	327	147	28	41	2	4	151

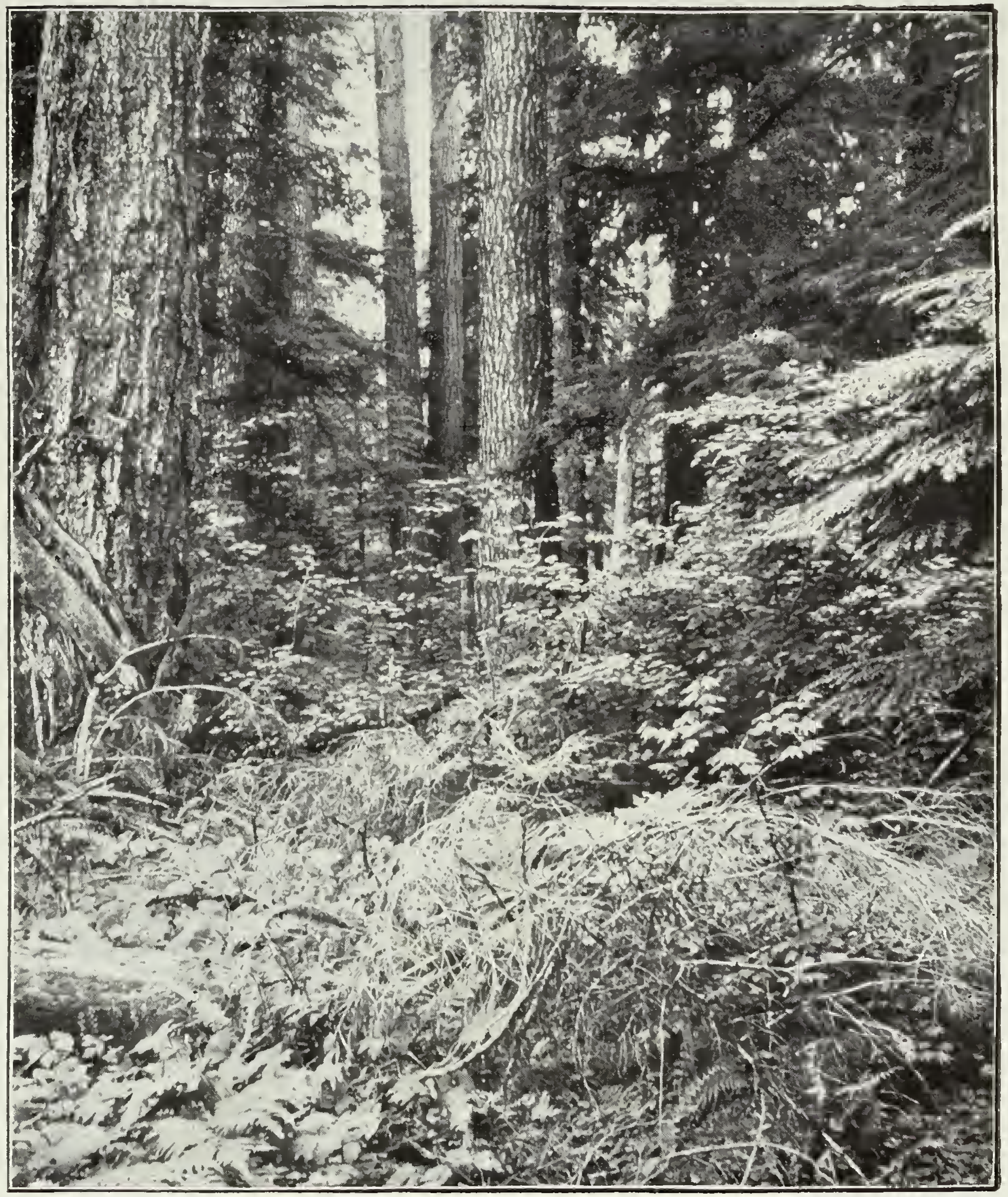
A. QUILLAYUTE PRAIRIE.



B. CEDAR TIMBER ON ELWHA RIVER; ELEVATION 250 FEET.



A. SPRUCE NEAR LAKE OZETTE.



B. FIR TIMBER NEAR FORKS PRAIRIE.

TOWNSHIP 28 NORTH, RANGE 13 WEST.

This township, lying toward the western part of the reserve, is made up in considerable part of low bottom land along the Kalawa and Bogachiel rivers, rising in the south in somewhat broken ridges. The soil is clay and sandy loam, and gravel on the ridges. The underbrush is dense. The township has a heavy stand of timber, consisting in the main of hemlock, red fir, spruce, and silver fir, with a little cedar. It is nearly all of good quality.

The timber can be logged to the Kalawa and Bogachiel rivers, which are good driving streams, and the area can be logged quite cheaply.

Forest conditions in T. 28 N., R. 13 W., Washington.

Timbered area	acres	21,580
Forks Prairie	do	1,460
Total stand of timber	feet B. M.	951,500,000
Average stand per acre	feet	44,100
Depth of humus	inches	3
Litter		Light.

Statistics of forest trees in T. 28 N., R. 13 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	131	219	44	46	5	7	223
Cedar	31½	129	40	24	8	25	179
Hemlock	512	125	21	27	5	7	115
Spruce	152	184	47	51	3	5	153
Silver fir	125	148	30	43	3	4	157

TOWNSHIP 28 NORTH, RANGE 14 WEST.

This township lies in the valley of Soleduck and Dickey rivers and consists in the main of gently rolling bench and bottom lands. The soil is commonly clay and loam, with clay and gravel in the uplands. The underbrush is dense everywhere. The timber consists mainly of hemlock and spruce, with a little fir and scattering cedar, all of good quality. The spruce timber is found along the rivers and is large and valuable.

The timber can be logged to the rivers which traverse it, which are good logging streams at all seasons of the year, and timber can be gotten out very cheaply. This township contains considerable areas of prairie land lying between the Soleduck and Dickey rivers. The largest of these areas is that known as Quillayute Prairie.

Forest conditions in T. 28 N., R. 14 W., Washington.

Timbered area	acres	21,370
Prairie area	do	1,670
Total stand of timber	feet B. M.	722,000,000
Average stand per acre	feet	33,800
Depth of humus	inches	3
Litter		Light.

Statistics of forest trees in T. 28 N., R. 14 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	50	192	45	47	5	6	205
Cedar	14½	131	28	21	7	23	174
Hemlock	350½	124	19	22	5	8	141
Spruce	307	183	55	58	3	5	188

Township 28 North, Range 15 West.

This fractional township lies upon the Pacific coast, at the mouth of Quillayute River. Its surface is in the main gently rolling, consisting of bottom and bench lands of the river. The soil is of clay and sandy loam. The underbrush is extremely dense. The timber consists mainly of hemlock, with some spruce and cedar. The spruce is good quality, but the cedar and hemlock are second rate.

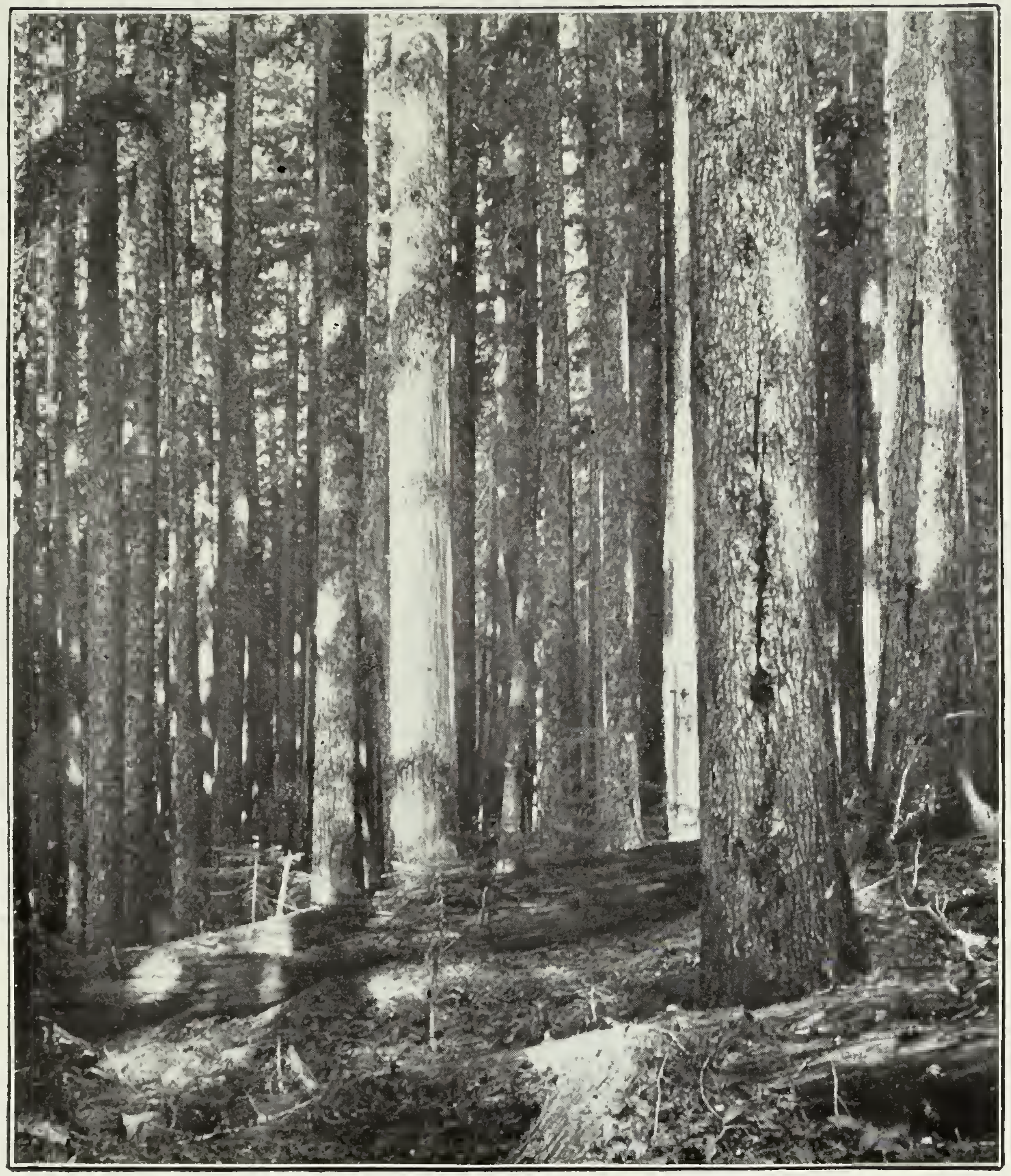
The timber, with the exception of a small tract in the southeast corner of the township, can be logged to the Quillayute River, which is a good logging stream; but as there is no harbor at its mouth it will be necessary to mill the timber within the township.

Forest conditions in T. 28 N., R. 15 W., Washington.

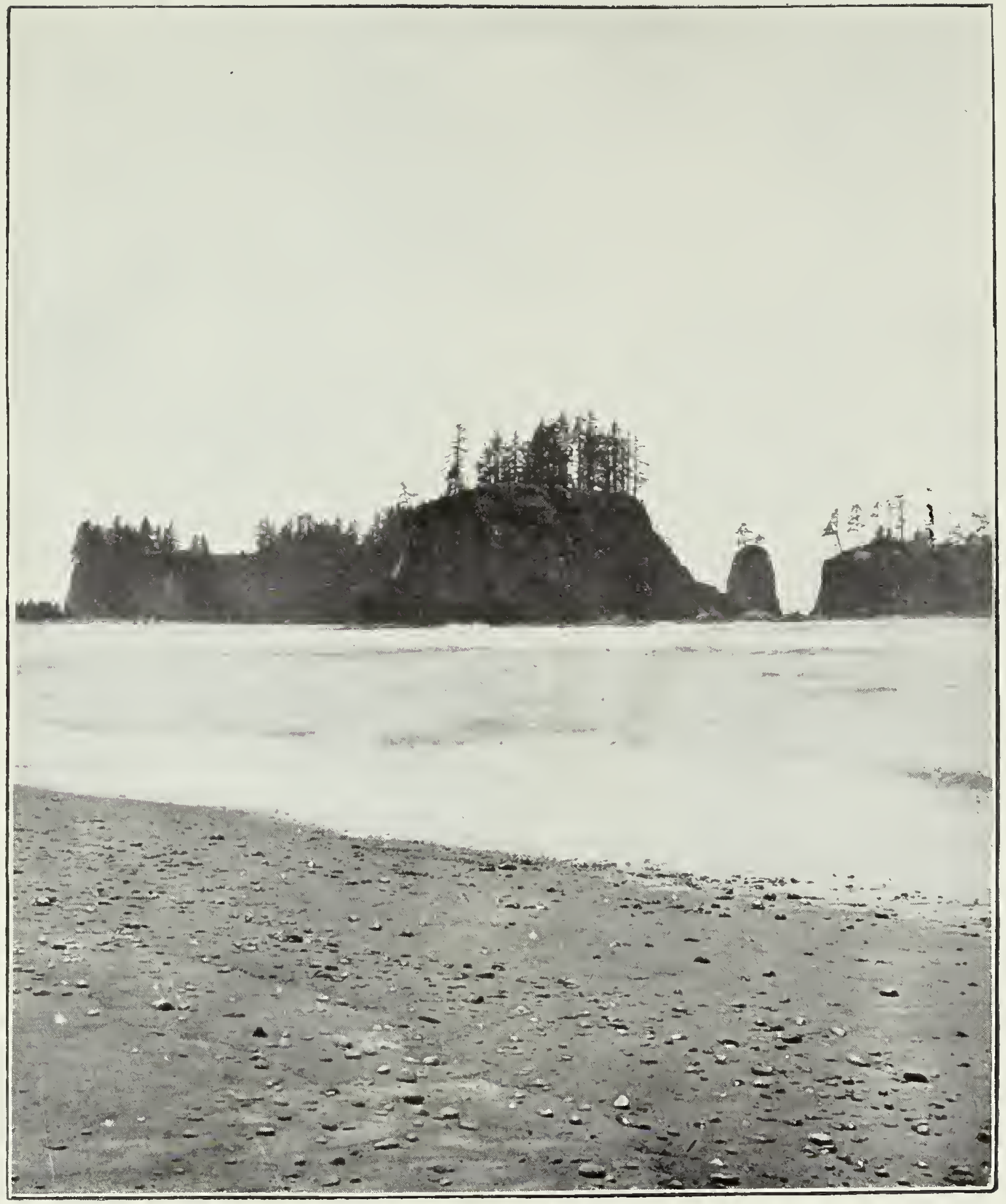
Timbered area	acres	13,765
Prairie area	do	235
Total stand of timber	feet B. M.	318,500,000
Average stand per acre	feet	23,100
Depth of humus	inches	3
Litter		Heavy.

Statistics of forest trees in T. 28 N., R. 15 W., Washington.

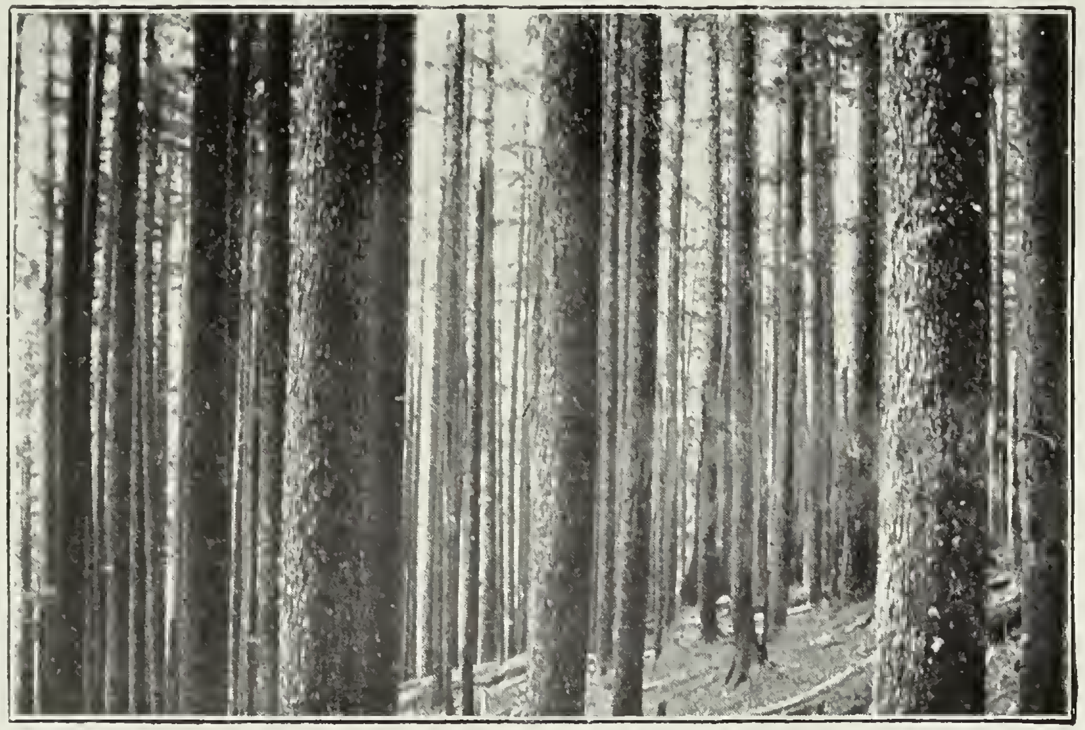
Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Cedar	14	111	44	22	8	24	200
Hemlock	251	126	21	24	7	9	135
Spruce	53½	159	41	33	4	7	183



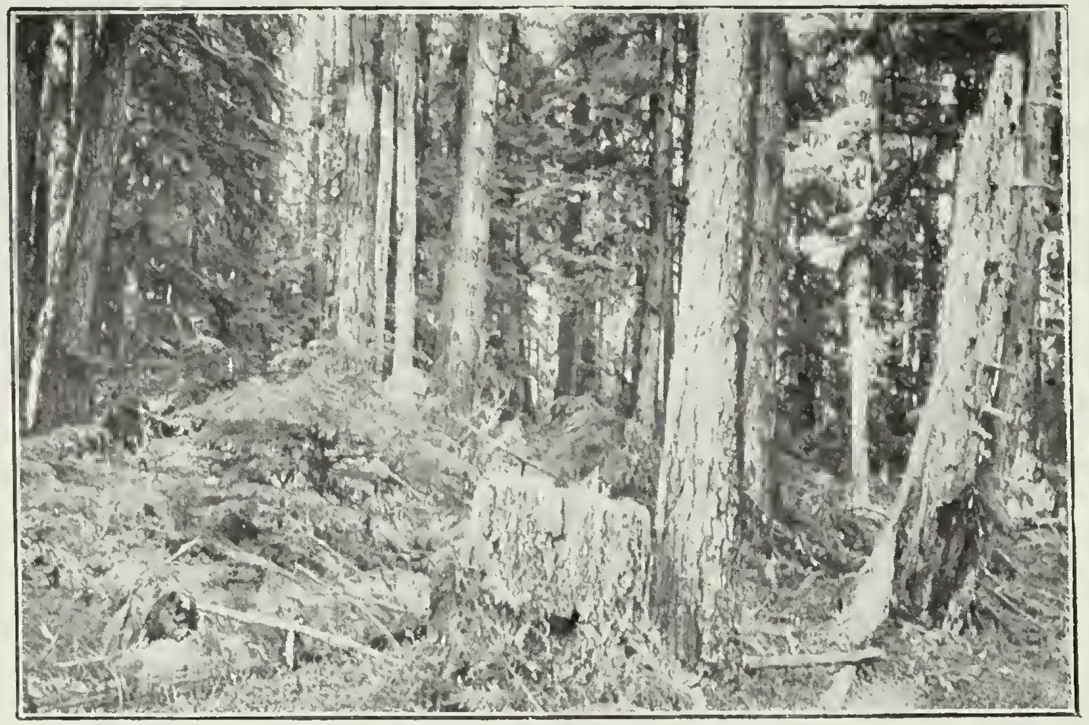
A. HEMLOCK AND FIR TIMBER ON SOLEDUCK RIVER; ELEVATION 3,000 FEET.



B ROCKS AT LA PUSH, MOUTH OF QUILLAYUTE RIVER.

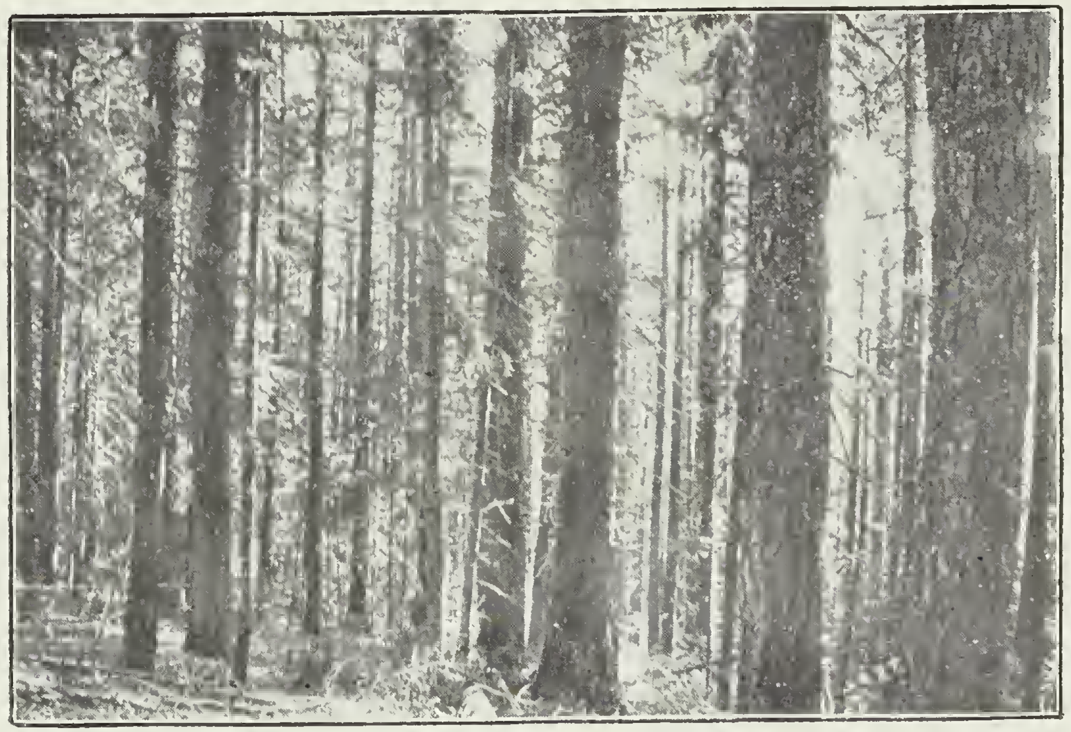


A. FIR AND HEMLOCK ON SOLEDUCK RIVER, 3 MILES ABOVE HOT SPRINGS.



B. FIR TIMBER ALONG EDGE OF FORKS PRAIRIE, SEC. 9, T. 28 N., R. 13 W.

C. FIR AND HEMLOCK TIMBER ON NORTH FORK KALAWA RIVER, T. 29 N., R. 11 W.



D. FIR TIMBER IN SEC. 4, T. 29 N., R. 10 W.

TOWNSHIP 29 NORTH, RANGE 3 WEST.

This township, in the eastern part of the reserve, is composed of rolling bench land which becomes steep on the west, sloping down to the valley of Dungeness River. The soil is mainly clay. The underbrush is dense. On the south and west of this township the timber has all been killed by fire and is standing in good condition. If cut immediately, it will make excellent lumber, but is in constant danger of destruction by fire.

The timber consists chiefly of fir of excellent quality. With it there is some cedar and hemlock, but it is small and poor.

The timber, with the exception of a small part in the west sloping to Dungeness River, can be logged to Squim Bay, in the northeast corner of the township, and can be taken out very cheaply.

Forest conditions in T. 29 N., R. 3 W., Washington.

Timbered area	acres	15, 150
Burned area	do	6, 890
Total stand of timber	feet B. M.	738, 250, 000
Average stand per acre	feet	48, 700
Depth of humus	inches	3
Litter		Heavy.

Statistics of forest trees in T. 29 N., R. 3 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	506	183	39	49	33	14	214
Cedar	24¾	123	31	26	50	22	209
Hemlock	208½	135	23	26	38	19	137

TOWNSHIP 29 NORTH, RANGE 4 WEST.

This township, situated in the northeastern part of the reserve, has been greatly burned over. It is drained by Dungeness River and McDonald Creek. It consists of high, rolling country sloping toward the north. The soil is clay and gravel on the north, changing to a stony soil in the south. Underbrush is very dense. The timber on this township is mainly fir and cedar, with a little hemlock. The fir timber is small except in the eastern part of the township, where it is large and of good quality. Most of this township has been burned over and the timber left standing is scattered in small bodies.

The timber in the eastern part of this township can be logged to Dungeness River, although this is a poor logging stream, with low banks and many gravel bars. A railroad could be built up its valley at slight expense, however. The timber in the western part can be logged by way of McDonald Creek, using skid roads.

The valley of Dungeness River has been to a large extent cleared and is quite thickly settled.

Forest conditions in T. 29 N., R. 4 W., Washington.

Timbered area	acres	2, 240
Burned area	do	13, 440
Grazing area	do	320
Total stand of timber	feet B. M.	217, 750, 000
Average stand per acre	feet	97, 200
Humus	inches	2
Litter		Light.

Statistics of forest trees in T. 29 N., R. 4 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	132¾	161	35	38	27	9	193
Cedar	72¾	106	22	22	70	23	161
Hemlock	12¼	98	16	27	31	10	133

Township 29 North, Range 5 West.

The southern part of this township is very steep and mountainous, descending northward into a rolling country. The soil in the northern and lower part is gravelly clay, while in the mountainous southern portion it is coarse gravel. The underbrush is dense on the north, becoming sparser southward. The timber consists mainly of fir and hemlock, with a little cedar and silver fir. The fir is of good quality. The other timber is of little value.

The timber on this township can be logged northward by means of skid roads or tramways.

Forest conditions in T. 29 N., R. 5 W., Washington.

Timbered area	acres	15, 360
Burned area	do	7, 040
Rocky area	do	640
Grazing area	do	640
Total stand of timber	feet B. M.	360, 250, 000
Average stand per acre	feet	23, 500
Depth of humus	inches	2
Litter		Medium.

Statistics of forest trees in T. 29 N., R. 5 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	169	170	30	41	16	9	198
Cedar	20¼	125	23	23	30	23	188
Hemlock	119	109	15	19	20	11	144
Silver fir	52	96	20	18	9	9	139

TOWNSHIP 29 NORTH, RANGE 6 WEST.

This township lies in the northeastern part of the reserve, and is made up entirely of mountainous and rugged country of little value except for grazing purposes. The soil is thin and stony. The underbrush is light, excepting in the immediate gorges of three or four creeks. The timber consists chiefly of fir and hemlock, with a little silver fir and scattering cedars. The fir is of good quality, but the hemlock and silver fir are poor.

The timber of this township can mainly be logged to Morse Creek on the east side.

Forest conditions in T. 29 N., R. 6 W., Washington.

Timbered area	acres	13,952
Barren rocky area	do	896
Burned area	do	4,480
Upland pasture	do	371.2
Total stand of timber	feet B. M.	265,000,000
Average stand per acre	feet	19,000
Depth of humus	inches	2
Litter		Medium.

Statistics of forest trees in T. 29 N., R. 6 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	107	174	31	48	9	8	204
Cedar	5½	-------	--------	-------	12	--------	200
Hemlock	93	88	17	16	10	8	130
Silver fir	59½	83	19	18	7	8	133

TOWNSHIP 29 NORTH, RANGE 7 WEST.

This township is steep and mountainous, with the exception of a narrow strip along Elwha River. The soil is clay and gravel and it is very stony. The underbrush is dense along the river, but on the uplands it is light. The timber is chiefly fir and hemlock and is of second quality.

Most of the timber can be logged to Elwha River. This is a poor logging stream, but along its valley a railroad could be built for the purpose of transporting logs.

Forest conditions in T. 29 N., R. 7 W., Washington.

Timbered area	acres	20, 900
Rocky area	do	64
Burned area	do	980
Upland meadows	do	1, 100
Total stand of timber	feet B. M.	196, 500, 000
Average stand per acre	feet	9, 400
Depth of humus	inch	1
Litter		Light.

Statistics of forest trees in T. 29 N., R. 7 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	109	140	30	29	8	9	181
Cedar	9	84	31	19	15	23	177
Hemlock	69½	78	18	17	7	9	134
Silver fir	9	91	19	18	7	8	139

Township 29 North, Range 8 West.

This township, drained by Boulder and Barnes creeks, is entirely mountainous and broken. Parts of its area are rocky and without vegetation; other parts, lying above the limit of timber, are composed of high grass lands, while the timber is found on the slopes of the ridges and in the valleys of the creeks. The underbrush is heavy in the valleys and becomes sparser on the ridges. The timber consists of silver fir, hemlock, and a little red fir, all of poor quality.

The timber can be logged on the north to Lake Crescent by way of Barnes Creek, and on the south down Boulder Creek into Elwha River. It will be very expensive getting the timber out of this township, as owing to the steepness of the ridges it will have to be run down by chutes to the streams.

Forest conditions in T. 29 N., R. 8 W., Washington.

Timbered area	acres	20, 480
Rocky area	do	640
Mountain meadows	do	1, 920
Total stand of timber	feet B. M.	288, 500, 000
Average stand per acre	feet	14, 100
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 29 N., R. 8 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	18½	105	21	21	2	6	142
Hemlock	117½	76	18	14	3	9	122
Silver fir	152½	84	19	17	3	8	128

TOWNSHIP 29 NORTH, RANGE 9 WEST.

This township is in the main drained by the Soleduck River and its north fork. Its area is mountainous, steep, and very rugged. The soil is clay and gravel. The underbrush in the river valleys is dense, but on the uplands is light. The timber is chiefly made up of fir, with considerable hemlock and a trifling amount of other species. The fir is of good quality, except on the high divides where it becomes small. The hemlock and fir are of poor quality.

The timber can be logged to Soleduck River, with the exception of that in a few sections in the north which can be logged direct to Lake Crescent. The Soleduck, however, is not a drivable stream, and it will be necessary to construct a railroad up its valley. Outside of the timber in the immediate valley of the Soleduck this township will be expensive to log, owing to the steepness of the slopes and the ruggedness of the country.

Forest conditions in T. 29 N., R. 9 W., Washington.

Timbered area	acres	22, 400
Mountain meadows	do	640
Total stand of timber	feet B. M.	555, 000, 000
Average stand per acre	feet	24, 800
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 29 N., R. 9 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	306½	125	23	27	3	6	160
Cedar	1½	85	20	12	8	15	140
Hemlock	165	83	16	17	5	7	125
Spruce	3	175	40	49	2	4	180
Silver fir	79	88	18	17	4	6	125

Township 29 North, Range 10 West.

This township is drained almost entirely by Soleduck River. Its surface is nearly all steep, broken, and rugged, rising to a great elevation in the south part. Soil is clay and gravel. Underbrush is dense. The timber is chiefly fir and hemlock, with a trifling amount of silver fir. It is all of good quality and stands very heavily in the northern part of the township.

The timber can be logged to Soleduck River, with the exception of a few sections in the southwest corner, which can best be logged to the Kalawa. It will be expensive to transport the lumber down to the river, owing to the steepness and ruggedness of the country, but it can be done by building skid roads up the main branches of the river and chutes down the hillsides.

Forest conditions in T. 29 N., R. 10 W., Washington.

Timbered area	acres	23, 040
Total stand of timber	feet B. M.	862, 000, 000
Average stand per acre	feet	37, 400
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 29 N., R. 10 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent*	*Years.*
Fir	345	180	27	32	3	6	198
Cedar	4	100	25	22	8	15	156
Hemlock	418	130	18	25	4	6	134
Spruce	2	180	48	43	2	4	180
Silver fir	93	138	19	29	3	7	130

Township 29 North, Range 11 West.

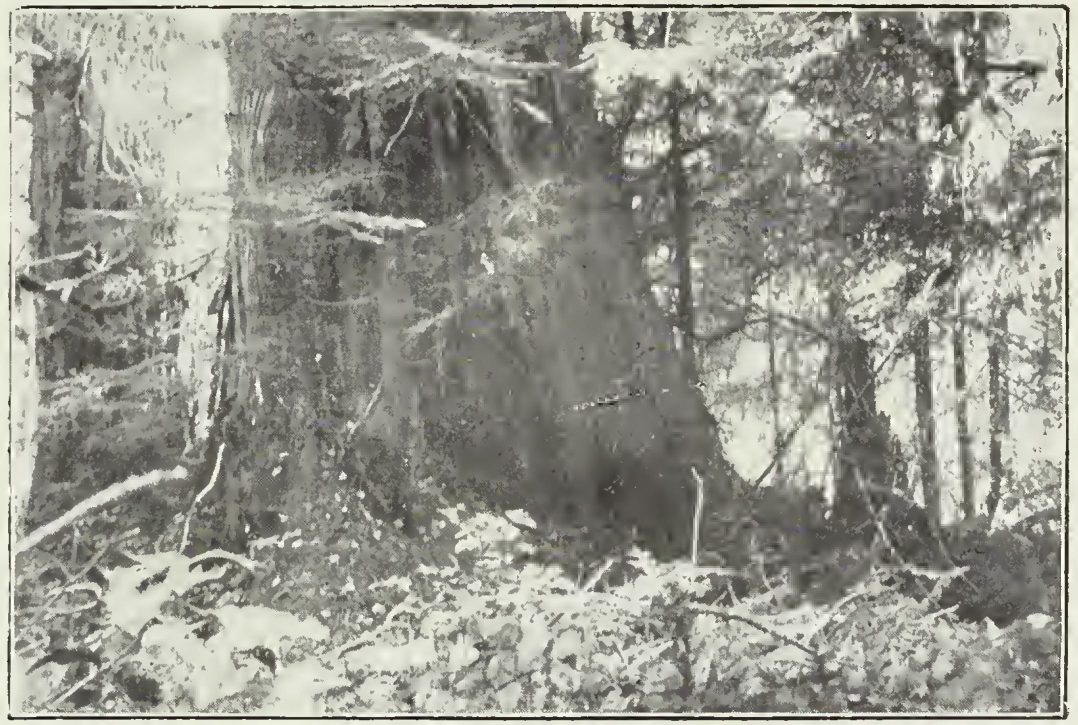
This township is drained mainly by the North Fork of Kalawa River. Its surface is nearly all steep and rolling and broken in the south. The soil is clay and gravel. The underbrush is heavy. It is heavily timbered with hemlock and fir, some silver fir, and a trifling amount of spruce and cedar. The timber is good, excepting on the high divides, where the elevation has prevented its development.

This timber can be logged to the North Fork of Kalawa River, with the exception of an area on the south line, which can be logged to the South Fork of Kalawa River.

A. HEMLOCK TIMBER, T. 29 N., R. 11 W.

B. FIR, HEMLOCK, AND CEDAR, SEC. 4, T. 29 N., R. 11 W.

C. HEMLOCK TIMBER, SEC. 15, T. 29 N., R. 11 W.



D. CEDAR TREE 18 FEET IN DIAMETER, DECAYED IN TRUNK, ON OZETTE INDIAN RESERVATION.

Forest conditions in T. 29 N., R. 11 W., Washington.

Timbered area	acres	22,440
Burned area	do	600
Total stand of timber	feet B. M.	889,250,000
Average stand per acre	feet	39,600
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 29 N., R. 11 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	255½	215	42	48	7	5	235
Cedar	8	101	29	24	8	19	161
Hemlock	456	133	26	51	11	8	151
Spruce	9¾	207	53	57	15	5	200
Silver fir	160	141	31	37	4	6	158

TOWNSHIP 29 NORTH, RANGE 12 WEST.

This township is drained in the main by the North Fork of Kalawa River. Its surface is very steep and broken, with the exception of the north tier of sections, which consist of gently rolling land. Soil is clay and gravel along the creeks and rivers, while on the uplands it is stony. Underbrush is dense. The timber consists mainly of hemlock and fir, with some silver fir and spruce and a little cedar, all of good quality.

This timber, with the exception of that in the northern portion, can be logged into the North Fork of Kalawa River, although this is a poor logging stream, with low banks and insufficient water for driving. A better plan for logging the township would be to construct a railroad along the valley of this stream. The timber would, however, in any case be expensive to handle, requiring chutes to transport it to the railroad or the river.

Forest conditions in T. 29 N., R. 12 W., Washington.

Timbered area	acres	22,240
Burned area	do	800
Total stand of timber	feet B. M.	1,152,500,000
Average stand per acre	feet	51,800
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 29 N., R. 12 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	387	219	45	59	5	8	221
Cedar	22½	134	43	25	9	18	204
Hemlock	519	137	22	29	7	10	143
Spruce	99	211	66	69	7	5	214
Silver fir	125	140	26	35	3	5	149

TOWNSHIP 29 NORTH, RANGE 13 WEST.

This township is drained mainly by Soleduck River, which flows through the middle. A small part in the southeast is drained by the Kalawa and in the northwest by Dickey River. The valley of the Soleduck contains much timbered bottom land and two small prairies, Shuwah and Maxfield, and considerable areas of the township have been burned. The country between the rivers is steep, rolling, and broken in the eastern part of the township, while in the western part it is gently sloping. The soil is clay and loam on the bottom lands, while the uplands are gravelly. Underbrush is everywhere dense. The timber is chiefly fir, spruce, and hemlock, all of good quality. The fir stands very heavily along Soleduck and Kalawa rivers. The hemlock is found mostly in the eastern part of the township, on the high ridges. Cedar is very scattering in this township and is of poor quality.

The timber can be logged into Soleduck River, with the exception of a small tract in the northwest corner, from which the timber should be taken to the East Fork of Dickey River, and another small portion in the southeast, which should go to the Kalawa River. The last is a good logging stream during winter season.

Forest conditions in T. 29 N., R. 13 W., Washington.

Timbered area	acres	21,960
Burned area	do	800
Prairie area	do	280
Stand of timber	feet B. M.	1,086,000,000
Average stand per acre	feet	49,500
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 29 N., R. 13 W, Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	384	206	46	57	6	9	220
Cedar	4	122	46	30	9	34	211
Hemlock	454	120	19	22	5	9	147
Spruce	196½	195	57	61	3	5	193
Silver fir	47½	151	28	32	3	5	158

TOWNSHIP 29 NORTH, RANGE 14 WEST.

This township is drained by the East and West Forks of Dickey River. Along the east streams and other branches is some timbered bottom land, while between them the country is steep and rugged. The soil is clay and loam along the rivers and in the swamps, while the uplands have gravel and clay soils. Underbrush is everywhere dense.

The timber is mainly hemlock, spruce, and cedar, more than half being hemlock. This and the spruce are of good quality. The cedar is large but overripe, most of it having dead tops. There is a small amount of fir in the township, mainly in the east tier of sections.

The timber can all be logged to Dickey River, which is a good logging stream below the forks in winter. It can also be logged cheaply with tramways and railroads built up the valleys of the river and its branches.

Forest conditions in T. 29 N., R. 14 W., Washington.

Timbered area	acres	23,000
Total stand of timber	feet B. M.	788,000,000
Average stand per acre	feet	34,300
Humus	inches	4
Litter		Heavy.

Statistics of forest trees in T. 29 N., R. 14 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	19	211	48	53	5	8	215
Cedar	78½	142	47	23	9	23	195
Hemlock	471½	127	20	22	5	9	150
Spruce	219	189	57	65	2	5	190

TOWNSHIP 29 NORTH, RANGE 15 WEST.

This township borders on the Pacific coast, the coast line running through the west tier of sections. It also contains the south end of Ozette Lake. The surface is rolling and the banks of some of the creeks are quite steep. It contains numerous swamps covered with a thick growth of cedar. The soil is a deep, red clay loam.

The timber consists of hemlock, cedar, and spruce of second-class quality. The cedar is in the main very large, but has hollow trunks, and most of the trees are dead at the top. Hemlock is mostly small. Spruce is rough and knotty and stands mostly along the coast, although in some cases along the banks of the creeks. The timber in the eastern part of this township can be logged to Dickey River, that in the northern to Ozette Lake, and that in the western to the Pacific.

Forest conditions in T. 29 N., R. 15 W., Washington.

Timbered area	acres	19, 200
Total stand of timber	feet B. M.	744, 750, 000
Average stand per acre	feet	38, 800
Depth of humus	inches	3
Litter		Heavy.

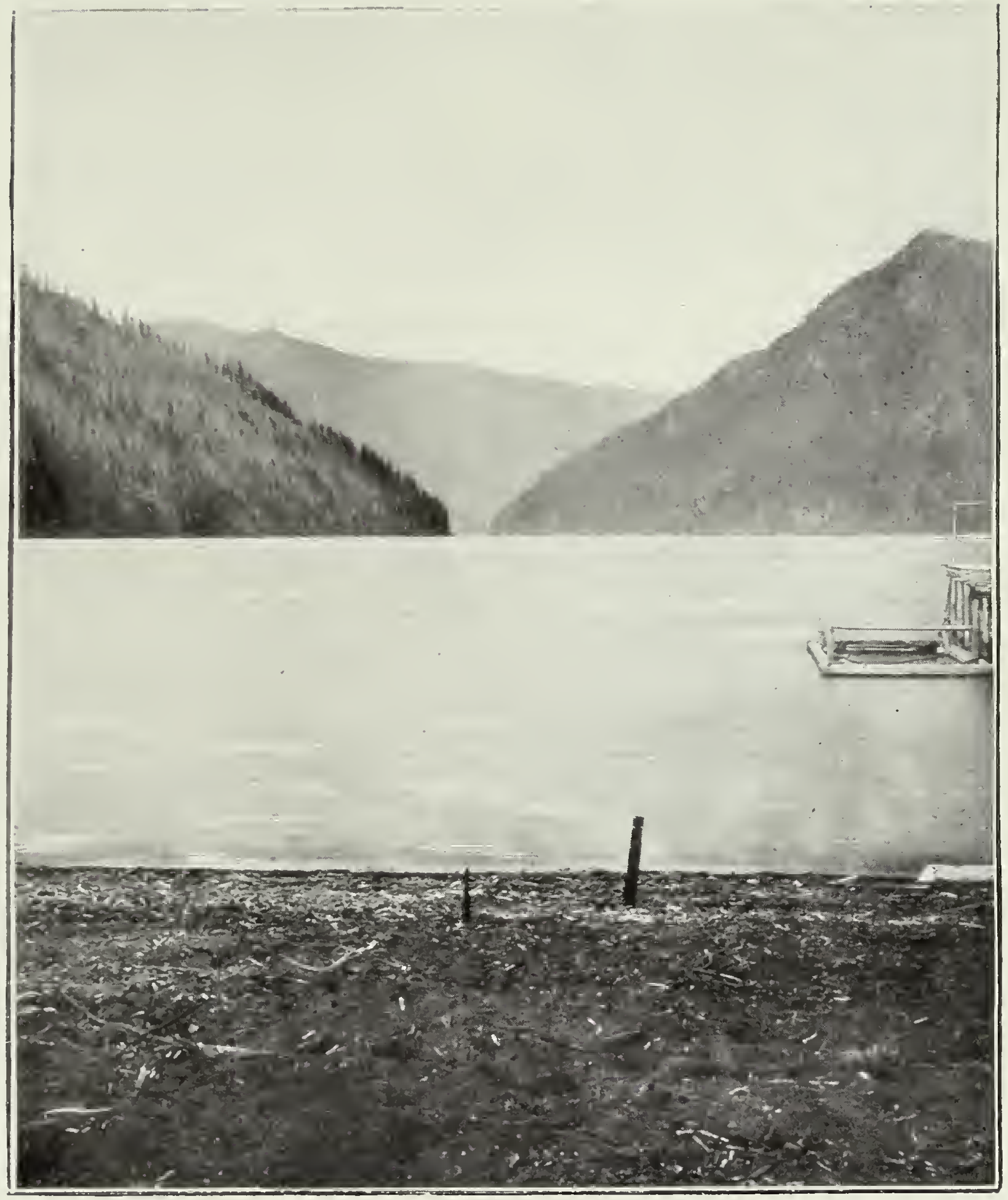
Statistics of forest trees in T. 29 N., R. 15 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Cedar	228¾	107	46	22	9	28	210
Hemlock	367	123	19	20	5	9	152
Spruce	149	180	51	50	3	5	149

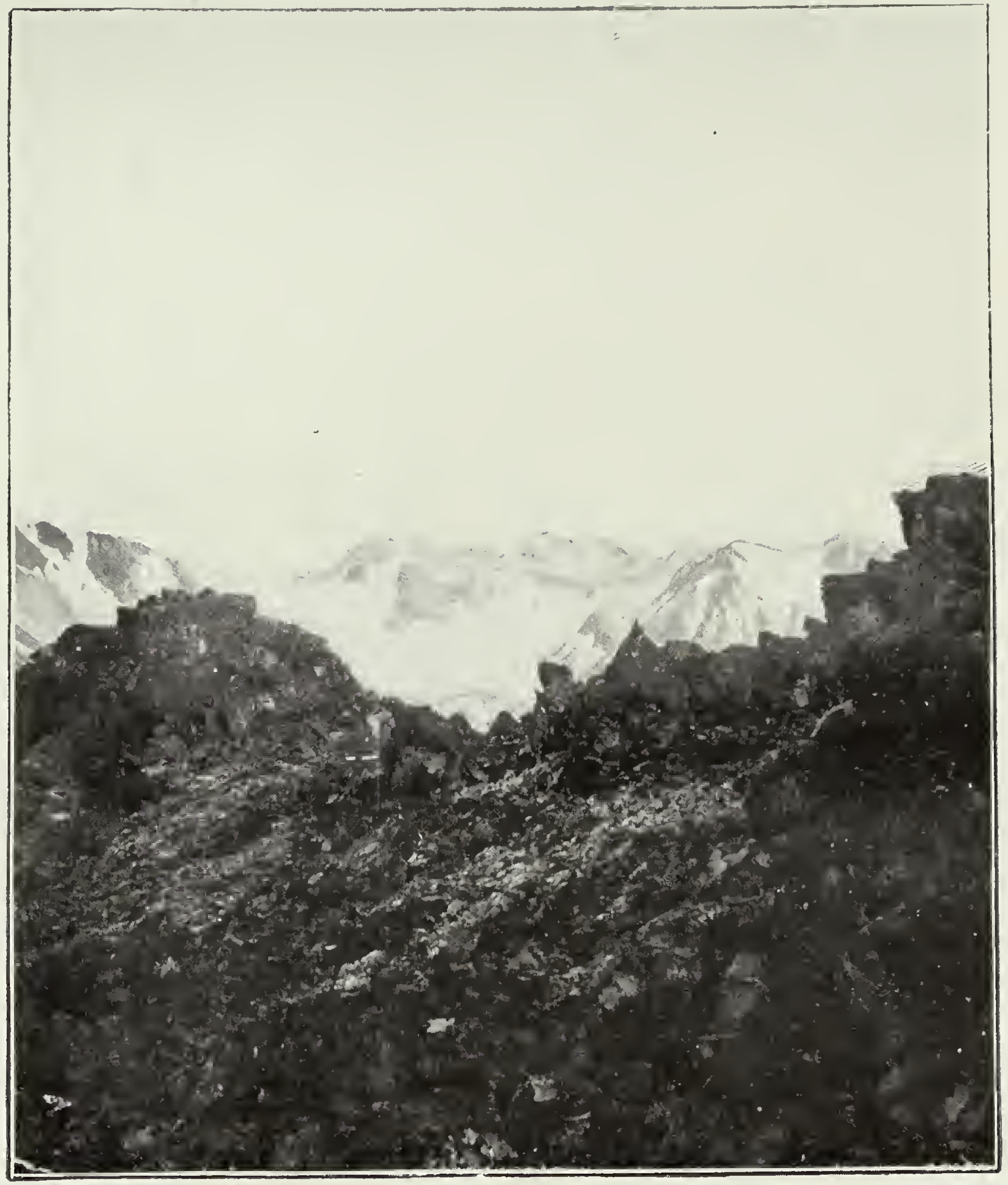
TOWNSHIP 30 NORTH, RANGE 9 WEST.

This township, lying in the northern part of the reserve, includes nearly all of Lake Crescent. The surface of the township is rugged and mountainous, the only exception being along the north line and the valley of Lyre River. The soil is clay in the lowlands and gravel upon the mountains. Underbrush is very dense. This township is heavily timbered, mainly with fir and hemlock, with a little cedar and spruce.

The timber can all be logged to Lake Crescent and Lyre River, with the exception of a small tract in the western part, which is tributary to the East Twin River. At present the Seattle Logging Company has a logging railroad built from Port Crescent, on the Strait of Juan de Fuca, to a point near the north line of this township, its intention having been to continue this road along Lyre River to the outlet of



A. LOOKING SOUTHEASTERLY FROM EAST END OF LAKE CRESCENT.



B. SNOW RANGE AT HEAD OF DUNGENESS RIVER.

the lake, when all the timber tributary to the lake can be logged into Lake Crescent and thence towed in rafts to the end of the railroad.

Forest conditions in T. 30 N., R. 9 W., Washington.

Timbered area	acres	22,336
Lake area	do	4,352
Burned area	do	1,115
Total stand of timber	feet B. M.	875,750,000
Average stand per acre	feet	39,200
Depth of humus	inches	3
Litter		Light.

Statistics of forest trees in T. 30 N., R. 9 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	549¾	170	36	45	5	7	194
Cedar	48½	115	31	24	9	25	162
Hemlock	203½	122	16	23	6	9	138
Spruce	16½	174	45	54	2	5	192
Silver fir	58	163	34	47	2	6	166

TOWNSHIP 30 NORTH, RANGE 10 WEST.

This township is in the northern tier of the reserve. Its surface is steep and mountainous, with the exception of a strip of bench land in the southern part along Soleduck River. The soil consists of gravel and clay, while the high divides are very stony. Underbrush is dense.

Timber consists mostly of fir and hemlock. The fir is all of good quality, and in the western part of the township is all large. Most of the hemlock is small in size and of second class. Along the south line of this township is a small amount of western white pine of good quality. More than half of this township, including the entire northwestern portion, has been burned over, destroying nearly all the timber.

The timber on this township can in the main be logged to Soleduck River, which is a good logging stream during the winter season, while the northern part of it can be logged by means of a railroad to be built from Lake Crescent.

Forest conditions in T. 30 N., R. 10 W., Washington.

Timbered area	acres	8,685
Burned area	do	14,355
Stand of timber	feet B. M.	397,500
Average stand per acre	feet	45,800
Depth of humus	inches	2
Litter		Heavy.

Statistics of forest trees in T. 30 N., R. 10 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	228	213	46	52	19	5	236
Cedar	9	104	34	22	6	7	200
Hemlock	160½	128	23	30	26	6	145

TOWNSHIP 30 NORTH, RANGE 11 WEST.

This township lies in the northern part of the reserve. Its surface is broken and very rugged, excepting in the southern part, along the Soleduck River, which is gently rolling. Its soil is clay or gravel along the river, while the upland is very rugged. Underbrush is dense everywhere.

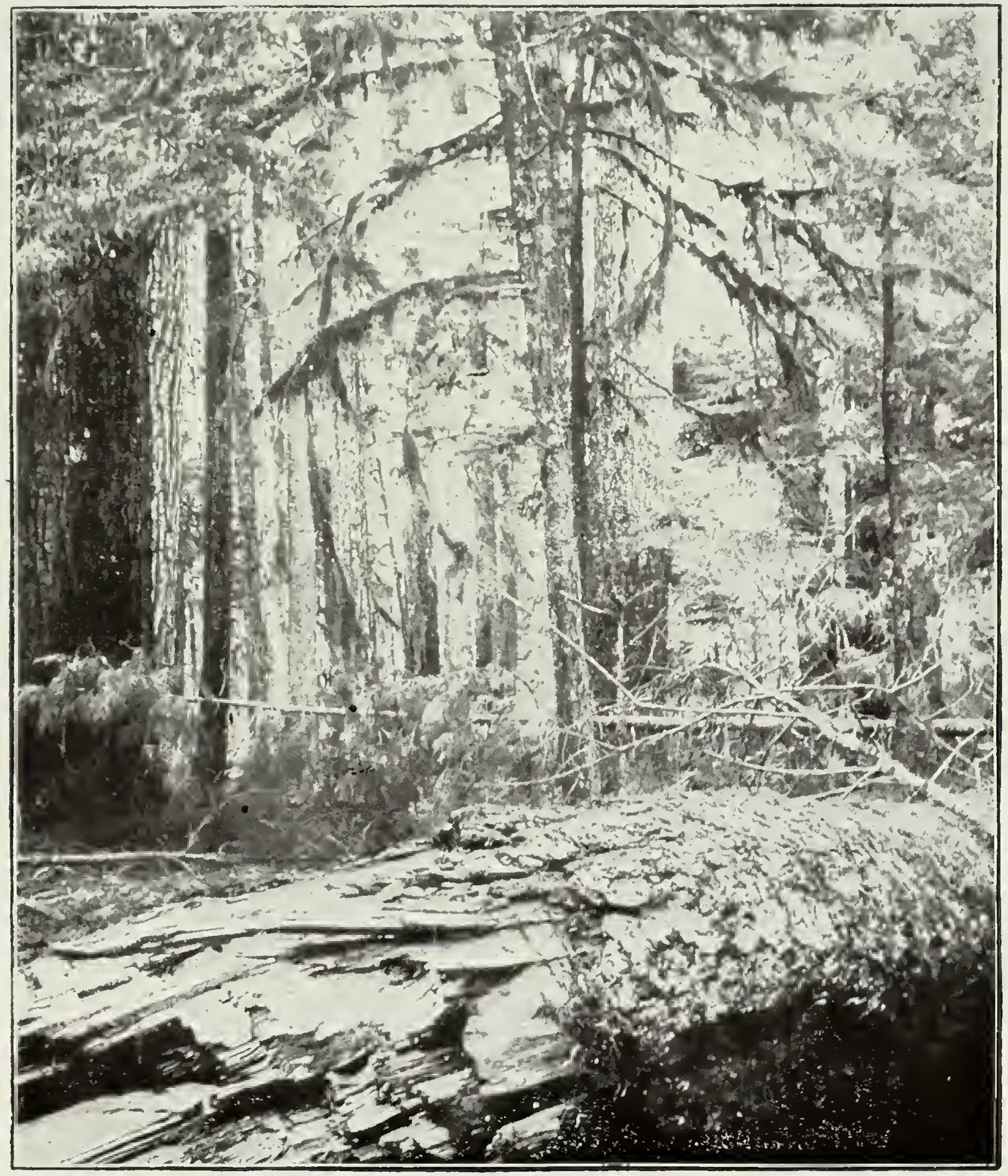
The timber consists chiefly of fir of good quality. The cedar and hemlock are scattering and of poor quality, having been to a large extent destroyed by fire. The spruce is good and is found only in small amounts along Soleduck River and Bear Creek.

The timber in this township can all be logged into Soleduck River, with the exception of a small tract in the northern part of the township which can be logged into the Pysht River. That part of the township which can be logged into the Soleduck can be gotten out very cheaply; that along Bear Creek, however, just to the north, will be somewhat expensive, as it will be necessary to build a railroad or tramway to the timber.

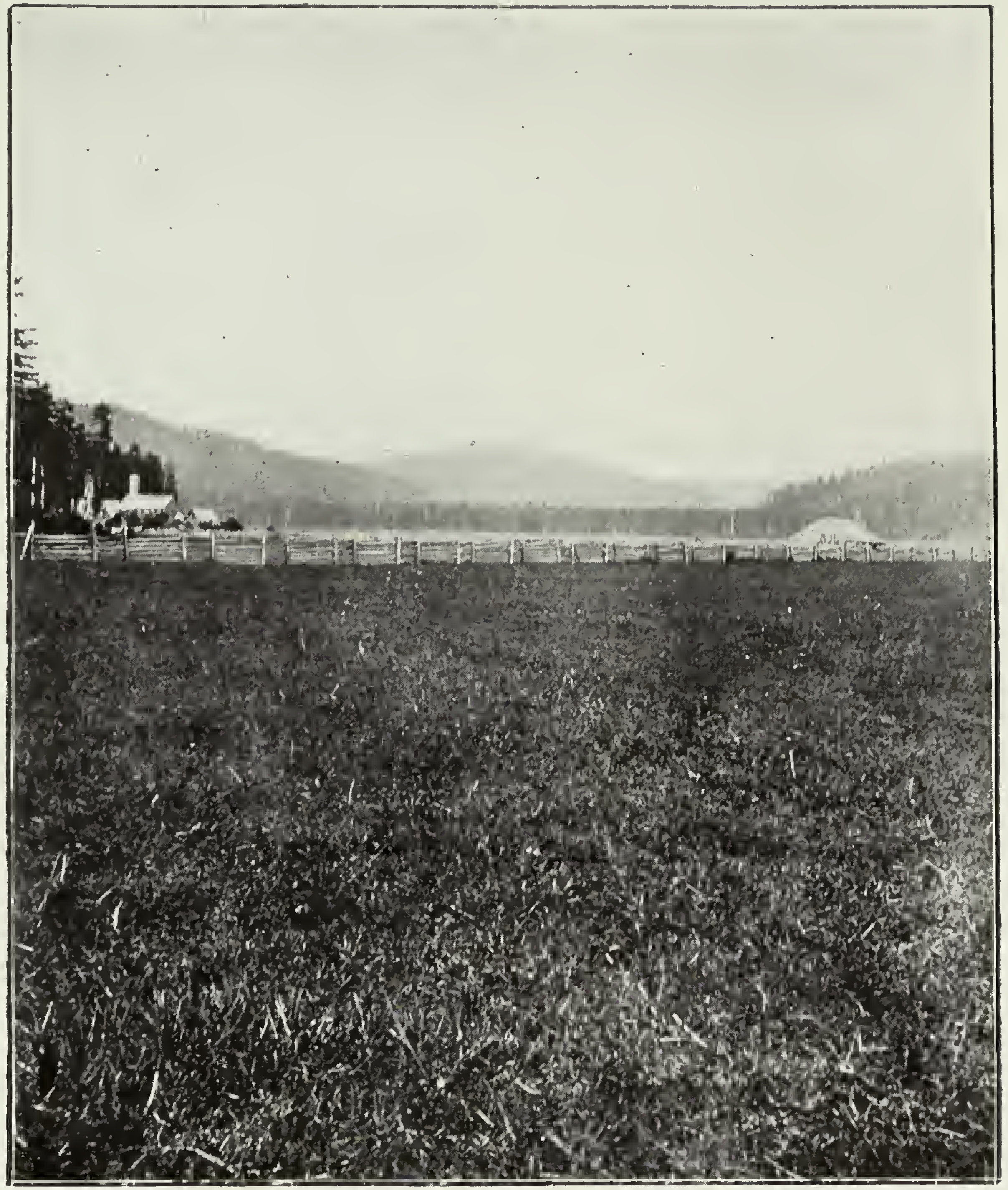
Two-thirds of the area of this township, including practically all of the high land outside of the immediate valley of the Soleduck, has been burned, being part of one of the great burns of this region.

Forest conditions in T. 30 N., R. 11 W., Washington.

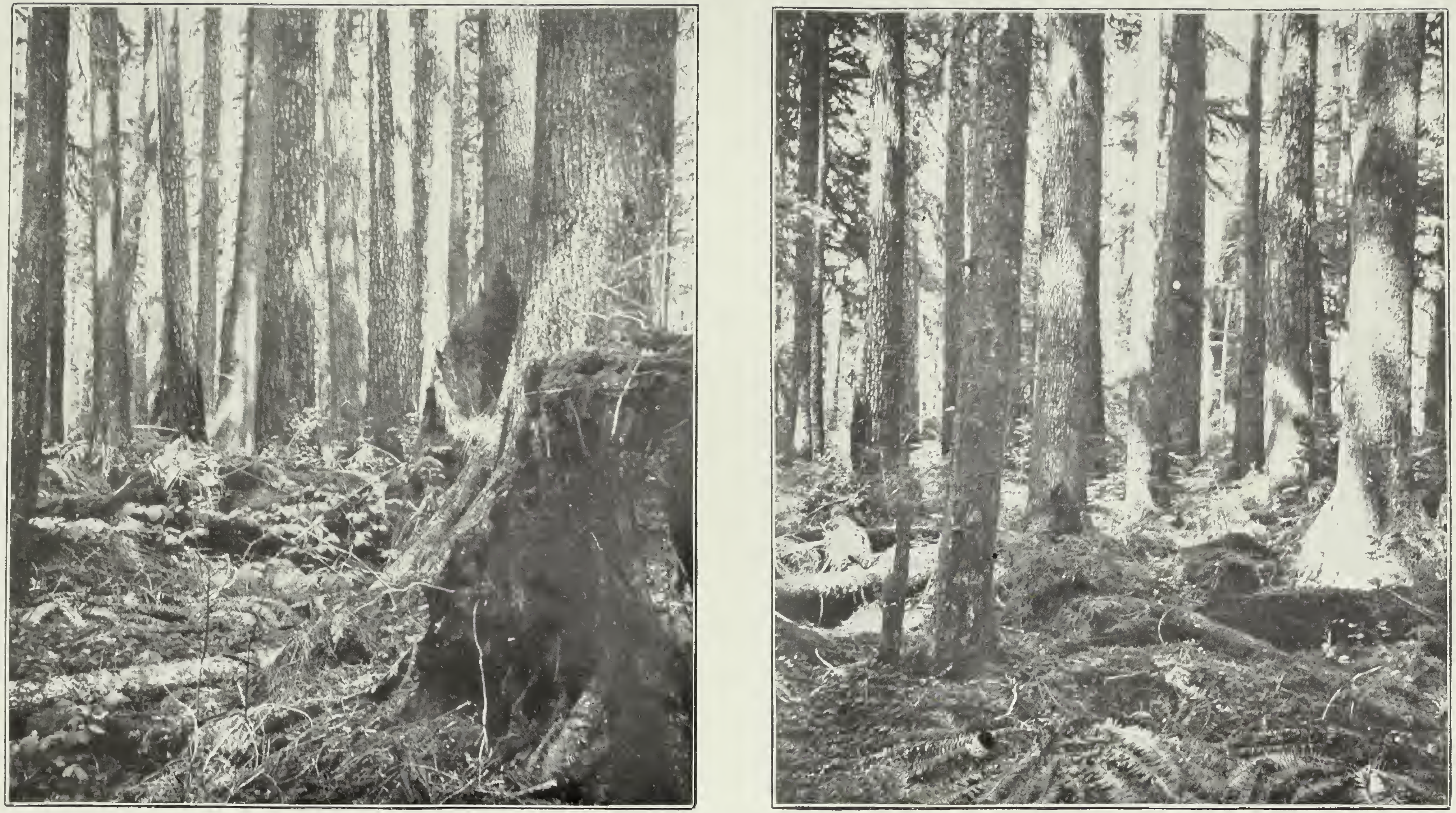
Timbered area	acres	7,935
Burned area	do	15,105
Total stand of timber	feet B. M.	375,250,000
Average stand per acre	feet	47,400
Depth of humus	inches	3
Litter		Heavy.



A. FIR TIMBER IN T. 30 N., R. 12 W., 100,000 FEET B. M. TO THE ACRE.



B. FORKS PRAIRIE.



A.

B.

FIR AND HEMLOCK IN T. 30 N., R. 12 W., ALONG SOLEDUCK RIVER.

Statistics of forest trees in T. 30 N., R. 11 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	216	218	41	73	10	8	217
Cedar	19¼	127	41	28	11	19	199
Hemlock	104	128	21	25	15	11	145
Spruce	22	198	59	59	12	6	201
Silver fir	14	137	19	30	8	7	147

TOWNSHIP 30 NORTH, RANGE 12 WEST.

The northern part of this township, which is one of the northern tier of townships of the reserve, is steep, broken, and rocky, descending southward to the valley of Soleduck River, which is mostly level bench land. The underbrush is dense and varied in character. The timber consists mainly of fir, hemlock, and spruce, with but little cedar or silver fir. The fir and spruce are of good quality, but have to a large extent been destroyed by fire. The hemlock is small and poor. The cedar is very scattering, and found mostly along the streams.

The timber on this township can all be logged to the Soleduck River, which is a good logging stream during the winter season. The work of moving the timber from the northern part of the township will, however, be somewhat expensive, owing to the rugged character of the country.

Forest conditions in T. 30 N., R. 12 W., Washington.

Timbered area	acres	17, 165
Burned area	do	5, 750
Prairie area	do	125
Total stand of timber	feet B. M.	746, 000, 000
Average stand per acre	feet	43, 400
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 30 N., R. 12 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	413	238	51	70	29	10	231
Cedar	15½	129	45	28	22	20	180
Hemlock	191½	126	20	31	24	9	139
Spruce	84	218	54	72	36	7	211
Silver fir	42	164	26	47	7	6	165

TOWNSHIP 30 NORTH, RANGE 13 WEST.

This township comprises the headwaters of the East Fork of Dickey River and Hoko River, also a small part of the drainage basin of the Soleduck, including Lake Pleasant. In the eastern part of the township is a heavy ridge, rising to an altitude of 2,540 feet, which is very steep and broken. In the northwestern part the township is also composed of high hills, rising to an altitude of 1,700 feet. The divide separating the East Fork of Dickey River from the Hoko is low, the valleys of the two streams being practically one. About Lake Pleasant in the southeast corner is much level land, including two patches of prairie.

The soil is clay and loam along the rivers, with red clay on the ridges. The prairie land, however, about Lake Pleasant is very gravelly and stony. The underbrush is dense.

The timber consists of fir, cedar, hemlock and spruce. The fir is abundant in the eastern part of the township and is all of good quality. The cedar, though large, is poor. Hemlock is all good except along the streams, where it is small and poor. The spruce, all of first-class quality and very large, is found near the rivers and about Lake Pleasant.

The timber on the north of the divide, between Hoko and Dickey rivers, can be logged down the valley of Hoko River by means of a railroad, since the river is not large enough to float logs. The southern part of the township can be similarly logged by means of a railroad up the valley of the Dickey. In the southeast corner about Lake Pleasant the timber can be logged directly into the Soleduck, which is a drivable stream.

Forest conditions in T. 30 N., R. 13 W., Washington.

Timbered area	acres	21,760
Burned area	do	3,150
Prairie area	do	410
Total stand of timber	feet B. M.	894,750,000
Average stand per acre	feet	41,100
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 30 N., R. 13 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	74½	243	54	77	14	9	223
Cedar	42¾	144	51	30	20	19	202
Hemlock	394½	105	21	29	17	9	142
Spruce	236½	226	62	81	24	6	209
Silver fir	146½	143	24	36	5	5	150

A. HEMLOCK TREE 4 FEET IN DIAMETER, SEC. 3, T. 30 N., R. 15 W., NORTH OF LAKE.

B. HEMLOCK TIMBER, SEC. 6, T. 30 N., R. 14 W.

C. VIEW OF CEDAR, WITH HEMLOCK TREE GROWING OUT OF TRUNK 20 FEET ABOVE THE GROUND, SEC. 18, T. 31 N., R. 14 W

D. HEMLOCK TREE 5 FEET IN DIAMETER, SEC. 12, T. 31 N., R. 15 W.

TOWNSHIP 30 NORTH, RANGE 14 WEST.

This township lies in the northwestern part of the reserve and contains Dickey Lake near the center in secs. 9 and 16.

The surface is steeply rolling on the east, rising to a height of 1,500 feet. The western and much the greater part of the township is gentle rolling land, with much level bottom land heavily timbered near the foot of Dickey Lake. The soil is clay and loam in the bottom lands, while the uplands are composed of red clay. Underbrush is very dense.

The timber is chiefly cedar, hemlock, and spruce, more than half the timber on the township being composed of hemlock. This stands heavily in the eastern part of the township and is of good quality, while that on the west is small and poor. The cedar is very large but poor, being of value only for shingle bolts. The spruce, which is found mainly near Dickey Lake and along the streams, is of good quality. The general outlet for this timber is to the south down the West Fork of Dickey River. This, however, is not large enough for driving logs, but shingle bolts and small timber can be driven during the winter season. A better outlet, however, would be by way of a railroad crossing the divide above Dickey Lake and going down Hoko River to the Strait of Juan de Fuca.

Forest conditions in T. 30 N., R. 14 W., Washington.

Timbered area	acres	16,000
Burned area	do	160
Timbered bottom lands	do	830
Total stand of timber	feet B. M.	883,500,000
Average stand per acre	feet	55,200
Depth of humus	inches	3
Litter		Light.

Statistics of forest trees in T. 30 N., R. 14 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	6	228	54	55	3	6	240
Cedar	200	129	51	24	9	30	216
Hemlock	485	125	21	23	6	9	152
Spruce	132½	182	51	52	3	5	190
Silver fir	60	157	34	40	2	4	165

TOWNSHIP 30 NORTH, RANGE 15 WEST.

This township, in the northwestern part of the reserve, contains most of Ozette Lake, which comprises approximately the equivalent of eleven sections in the middle of the township. Aside from this lake the area of the township is entirely forested.

The surface is in the main gently rolling, sloping toward the lake on both sides. The soil is clay and loam on the bottom land and on the upland it is red clay. The underbrush is dense.

The timber consists of hemlock, cedar, and spruce; mainly of the first two species. On the east side of the lake the hemlock is of good quality; that on the west is poor and small. The cedar is of poor quality in all parts of township, though large east of the lake. The trunks are commonly short and hollow at the base, but can be used for shingles. Spruce is of good quality and very large. It is found mainly on the bottom lands bordering the lake.

The timber can be logged to Ozette Lake, which can be reached by a railroad up Hoko River from the Strait of Juan de Fuca, or it could be milled at the lake and carried out as lumber.

Forest conditions in T. 30 N., R. 15 W., Washington.

Timbered area	acres	14, 080
Timbered bottom lands	do	1, 695
Total stand of timber	feet B. M.	591, 250, 000
Average stand per acre	feet	42, 000
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 30 N., R. 15 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Cedar	223	109	41	23	9	37	199
Hemlock	278	114	19	21	4	7	145
Spruce	90¼	173	47	46	3	5	177

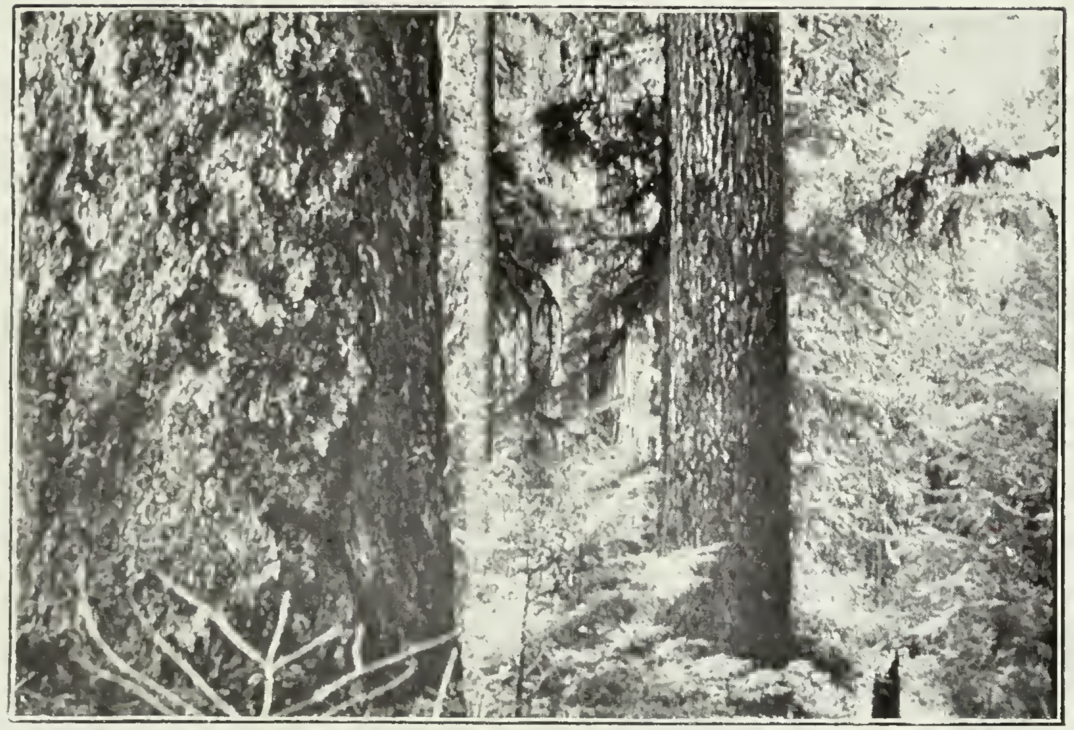
TOWNSHIP 30 NORTH, RANGE 16 WEST.

This is a fractional township, consisting of parts of the eastern tier of sections along the Pacific coast. The total area of the township does not exceed two sections. Its surface is gently rolling, dropping to the coast by a rocky bluff ranging in height from 60 to 160 feet. The underbrush is dense.

The timber consists of cedar, hemlock, and spruce, and is all of poor quality. It can be logged to the eastward into Ozette Lake.

A. SPRUCE TREE 10 FEET IN DIAMETER, ON BIG RIVER, SEC. 35, T. 31 N., R. 15 W.

B. HEMLOCK TIMBER, SEC. 8, T. 31 N., R. 14 W.



C. FIR TREE 8 FEET IN DIAMETER. SEC. 14. T. 31 N., R. 14 W.

D. HEMLOCK TIMBER, SEC 4, T. 31 N., R. 14 W.

Forest conditions in T. 30 N., R. 16 W., Washington.

Timbered area	acres	1,280
Total stand of timber	feet B.M.	31,000,000
Average stand per acre	feet	24,200
Depth of humus	inches	2
Litter		Light.

Statistics of forest trees in T. 30 N., R. 16 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Cedar	13¾	92	40	22	8	39	200
Hemlock	9½	103	20	19	5	8	143
Spruce	7¾	163	40	37	2	5	163

TOWNSHIP 31 NORTH, RANGE 14 WEST.

This township is in the northwestern part of the reserve. The northern part of it rises to an altitude of 2,000 feet above sea level, from which the land descends southward to the broad valley of Big River, a tributary of Ozette Lake, and eastward to Hoko River. Most of the area is rolling land, with low ridges. The soil is clay and loam on the bottom lands, while the uplands are also clay, but quite stony in places, especially in the northern part of the township. The underbrush is very dense.

The timber consists of hemlock, cedar, and spruce, with considerable silver fir and a little red fir. The total stand is very heavy, this being one of the most heavily timbered townships of the State. The hemlock is mainly of good quality and with a heavy stand, especially in the northern part of the township. The spruce also is very large and of good quality, being found mainly on the bottom lands in the south half of the township. The cedar timber is large, but of poor quality. It can, however, be used for shingles.

With the exception of a small tract in the northwest corner, the timber in this township can all be logged into Hoko River, which is a good logging stream, with good banks and sufficient water during winter season to drive them. Another outlet is by railroad from the Strait of Juan de Fuca up Hoko River and across a low divide to the valley of Big River. The southern part of the township can be logged very cheaply, but the northern part, being hilly, will be more expensive. It is probable that in this part of the township chutes will have to be employed for the transportation of timber.

Forest conditions in T. 31 N., R. 14 W., Washington.

Timbered area	acres	23, 040
Timbered bottom land	do	3, 945
Total stand of timber	feet B. M.	1, 171, 750, 000
Average stand per acre	feet	508, 600
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 31 N., R. 14 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	31	219	56	71	4	7	230
Cedar	291¾	116	54	30	10	33	219
Hemlock	539	127	26	31	4	9	148
Spruce	181	188	53	63	2	5	198
Silver fir	129	147	35	40	2	....	159.

Township 31 North, Range 15 West.

This full township lies in the northwestern part of the reserve, near the coast. The land rises at the summit to an altitude of over 1,000 feet, from which it descends on all sides and is drained by several small streams to the Pacific Ocean and to Ozette Lake to the south. In the southern part is considerable bottom and swamp land.

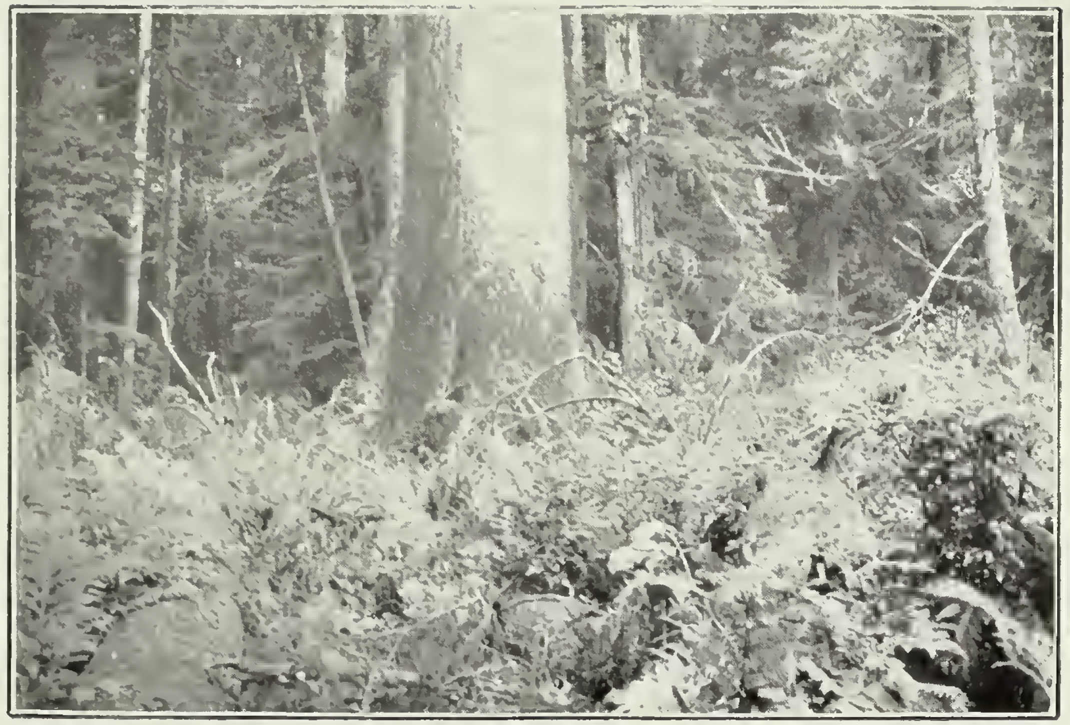
The underbrush is very dense, being made up of a great variety of plants.

The entire area, with the exception of a few acres burned, is timbered with a heavy stand, consisting mainly of cedar and hemlock, with some spruce and a little silver fir. The cedar is very large, but of poor quality, and makes a heavy stand in the southern part of the township. The hemlock, which is mainly in the northern part of the township, is of good quality. The spruce timber is very large and excellent. It has a heavy stand on the bottom lands in the southern part of the township.

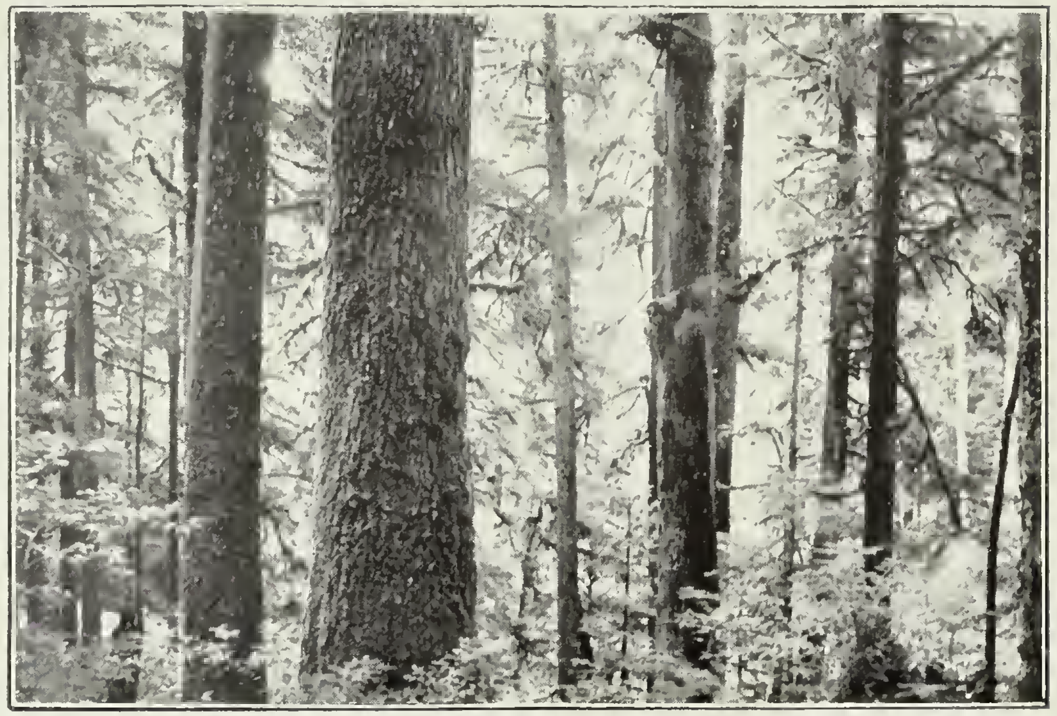
The timber in the northern part of this township will have to be logged to Ozette River, that in the southern part of it to Ozette Lake, or by railroad from Hoko River through a low divide. It can be logged very easily and cheaply.

Forest conditions in T. 31 N., R. 15 W., Washington.

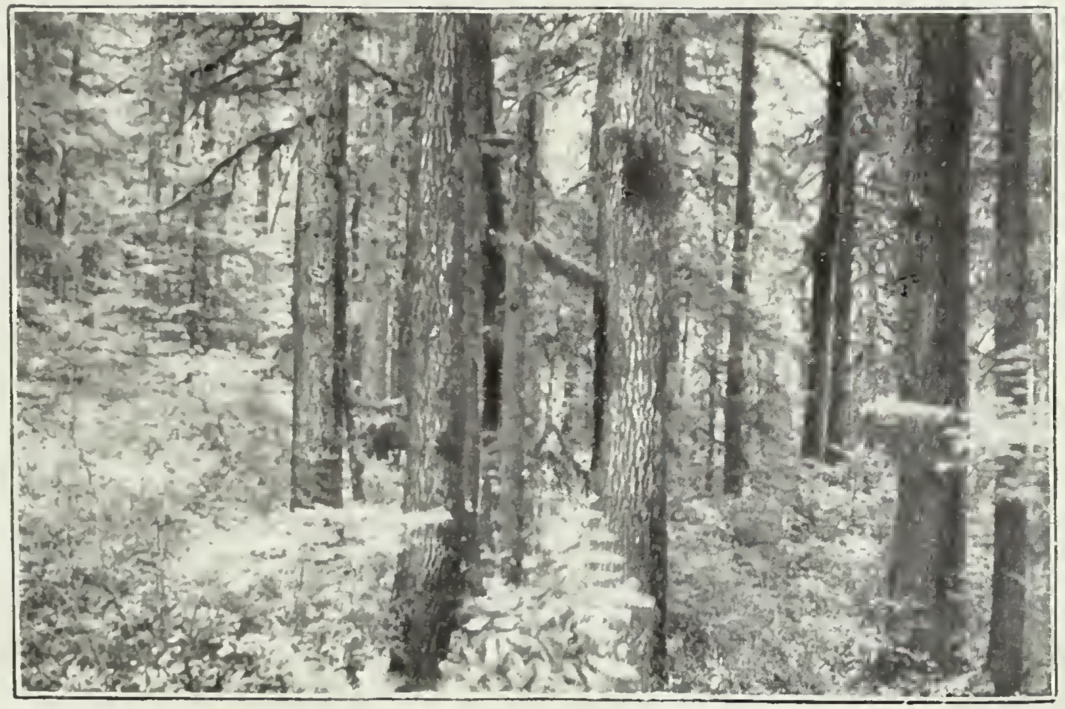
Timbered area	acres	23, 040
Burned area	do	60
Timbered bottom land	do	2, 800
Total stand of timber	feet B. M.	982, 000, 000
Average stand per acre	feet	42, 600
Depth of humus	inches	4
Litter		Heavy.



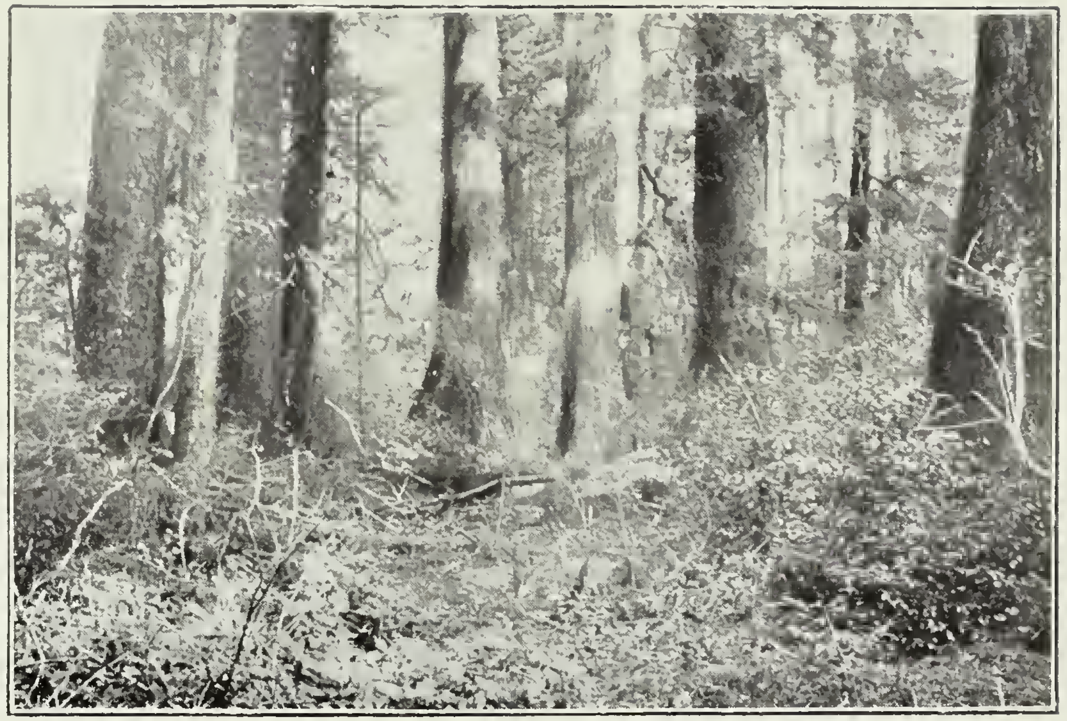
A. SPRUCE 8 FEET IN DIAMETER, SEC. 13, T. 31 N., R. 15 W.



B. HEMLOCK TIMBER ON SEC. 28, T. 31 N., R. 15 W.



C. HEMLOCK TIMBER NEAR COAST, T. 31 N., R. 15 W.



D. SPRUCE AND HEMLOCK, SEC. 29, T. 31 N., R. 15 W.

Statistics of forest trees in T. 31 N., R. 15 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Cedar	370½	111	48	30	10	35	219
Hemlock	429	122	23	26	5	8	144
Spruce	128	184	49	54	3	5	195
Silver fir	54½	149	33	38	2	5	159

TOWNSHIP 31 NORTH, RANGE 16 WEST.

This is a fractional township upon the Pacific coast, consisting of secs. 24, 25, and 36 and fractional secs. 1, 12, 13, 23, 26, and 35, together with Flattery Rocks, in sec. 21, and Ozette Island, in secs. 28 and 33. The township includes Ozette Indian Reservation, which comprises parts of secs. 23, 24, 25, and 26.

The surface is mainly a gentle slope toward the sea, dropping off on the coast line by a steep, rocky bluff ranging in height from 100 to 200 feet. The underbrush is very dense.

The timber consists of cedar, hemlock, and spruce, all of poor quality. It can all be logged to Ozette River, which flows through the township and is a good logging stream. There is, however, no harbor at its mouth; consequently it will be necessary to manufacture the timber on the spot or ship it out by railroad.

Forest conditions in T. 31 N., R. 16 W., Washington.

Timbered area	acres	3,520
Burned area	do	55
Total stand of timber	feet B. M.	96,750,000
Average stand per acre	feet	27,500
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 31 N., R. 16 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Cedar	53½	101	34	19	10	40	208
Hemlock	26½	98	18	20	6	10	141
Spruce	16¾	160	39	38	2	4	178

Township 32 North, Range 14 West.

This township, in the northwestern part of the reserve, has a broken, hilly surface drained to the eastward by Sekiu River. In the northern part of the township the land rises to an altitude of 1,000 feet, and in the southern part to a height of 1,800 feet. The soil is red clay and sandy, and stony on the divides and on the banks of the creeks. The underbrush is very dense.

The timber can all be logged to the Sekiu River, with the exception of that in a small tract in the southwest corner of the township, which can be logged down the Suez. Sekiu River is a poor logging stream, not having sufficient water for driving large logs, although shingle bolts can be driven during the winter season. The valley along the river affords a good route for a railroad, which can be built very cheaply into this township.

This is the most heavily timbered township in the reserve, and one of the most heavily timbered in the State of Washington. The timber consists chiefly of hemlock and silver fir, of large size and excellent quality. The cedar timber, though large, is poor. Spruce is very scattering, being found only on the creeks and along the Sekiu River. Fir timber is limited to a small area, most of it being in the northeast corner of the township.

Forest conditions in T. 32 N., R. 14 W., Washington.

Timbered area	acres..	23,040
Total stand of timber	feet B. M..	1,360,000,000
Average stand per acre	feet..	59,000
Depth of humus	inches..	3
Litter		Medium.

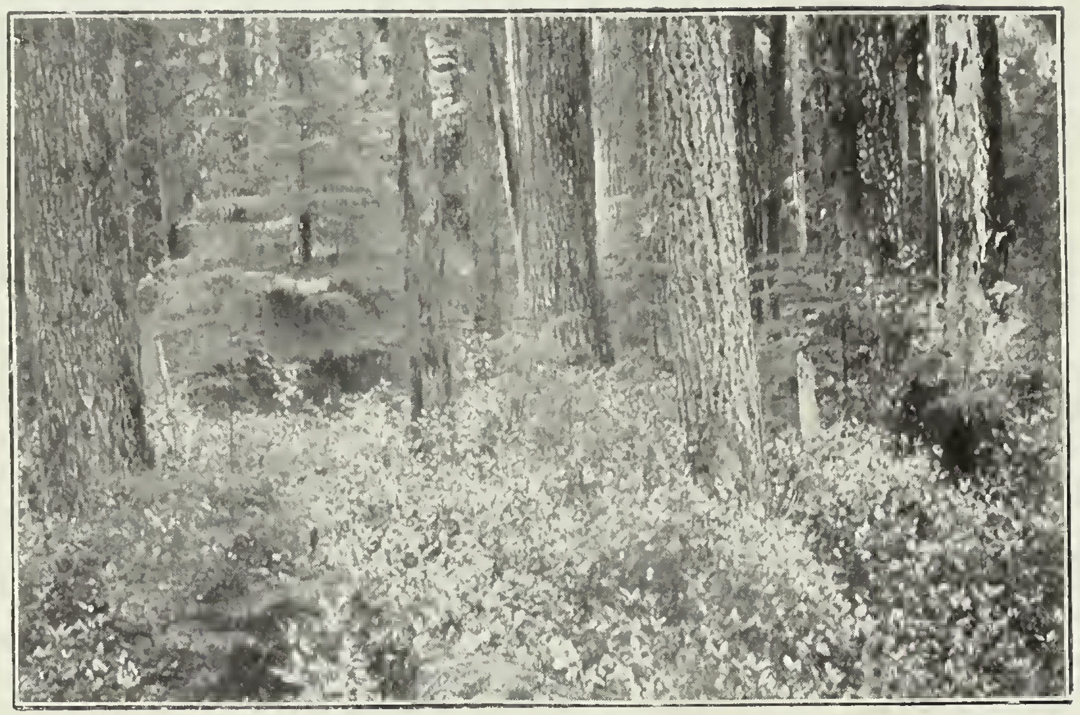
Statistics of forest trees in T. 32 N., R. 14 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	37¾	205	45	50	4	7	218
Cedar	286½	119	50	30	9	28	220
Hemlock	669	134	28	33	4	7	152
Spruce	34¾	187	41	53	2	4	195
Silver fir	332	155	33	42	3	5	163

Township 32 North, Range 15 West.

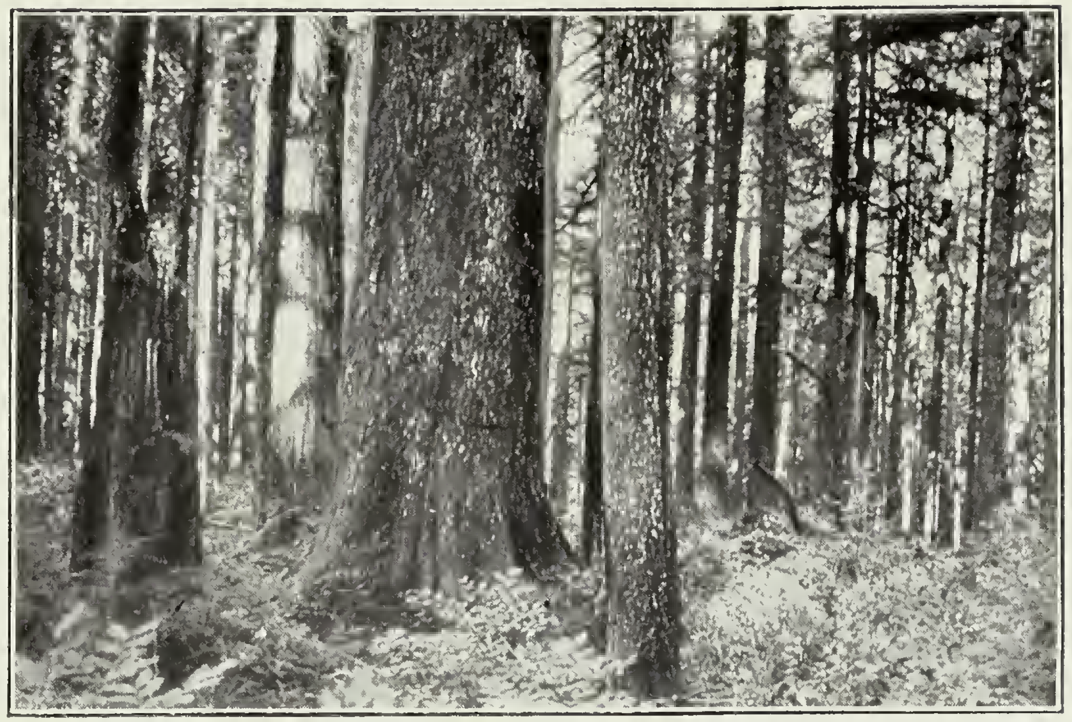
This is a fractional township, consisting of secs. 19 to 36, inclusive, and the south half of secs. 13 to 18, the remainder of the township being included in the Makah Indian Reservation. Secs. 18 and 19 are fractional, as they extend to the Pacific Ocean.

A. CEDAR TREES, SEC. 26, T. 31 N., R. 15 W.

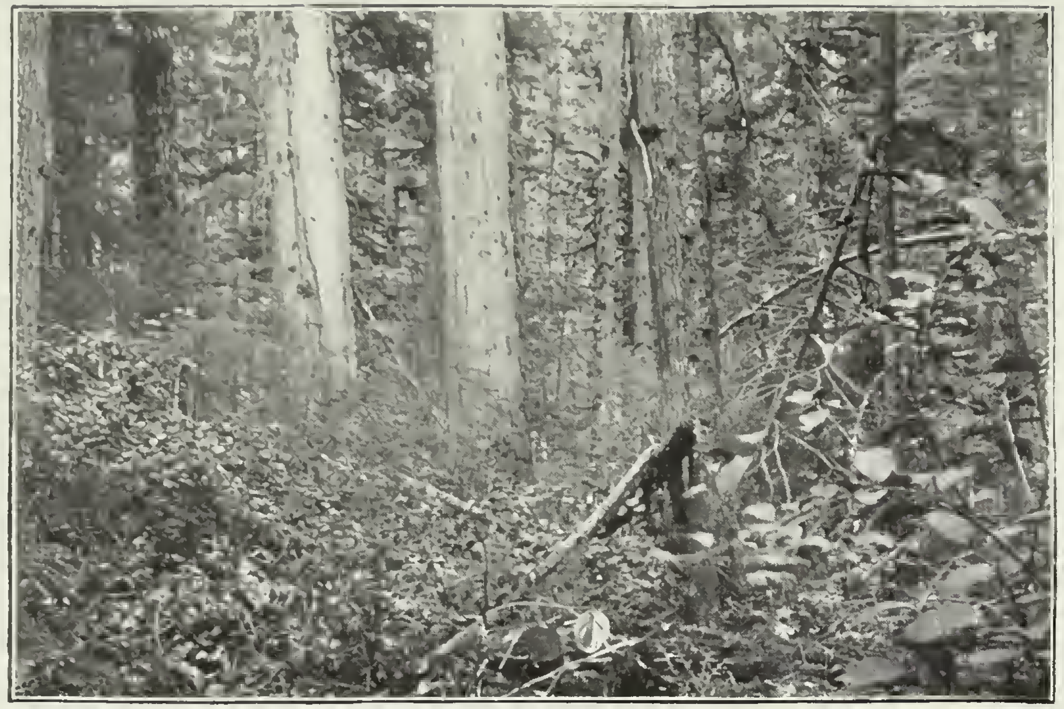


B. HEMLOCK, T. 32 N., R. 14 W.

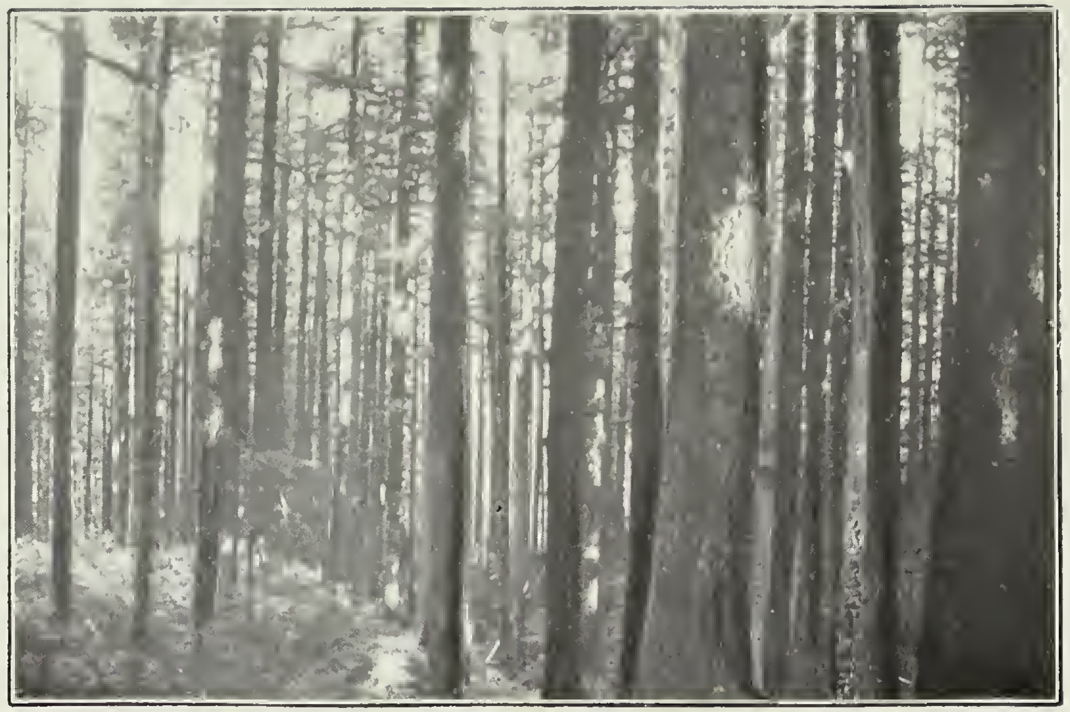
C. CEDAR AND HEMLOCK. SEC. 30, T. 32 N., R. 14 W.



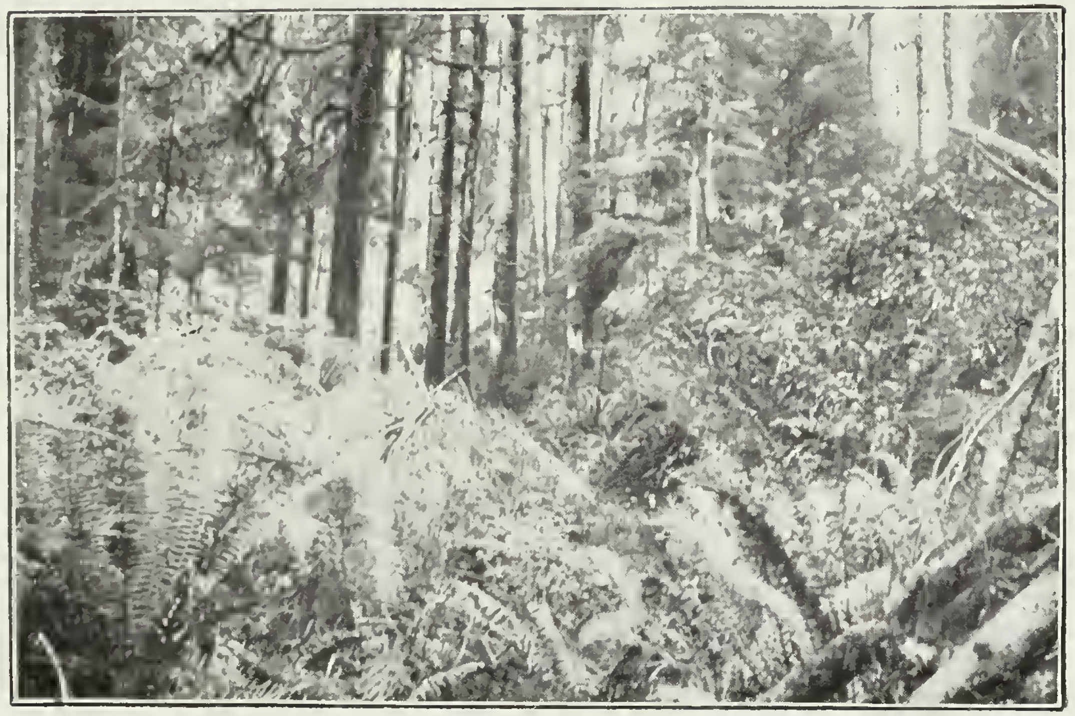
D. HEMLOCK TIMBER, SEC. 20, T. 32 N., R. 14 W.



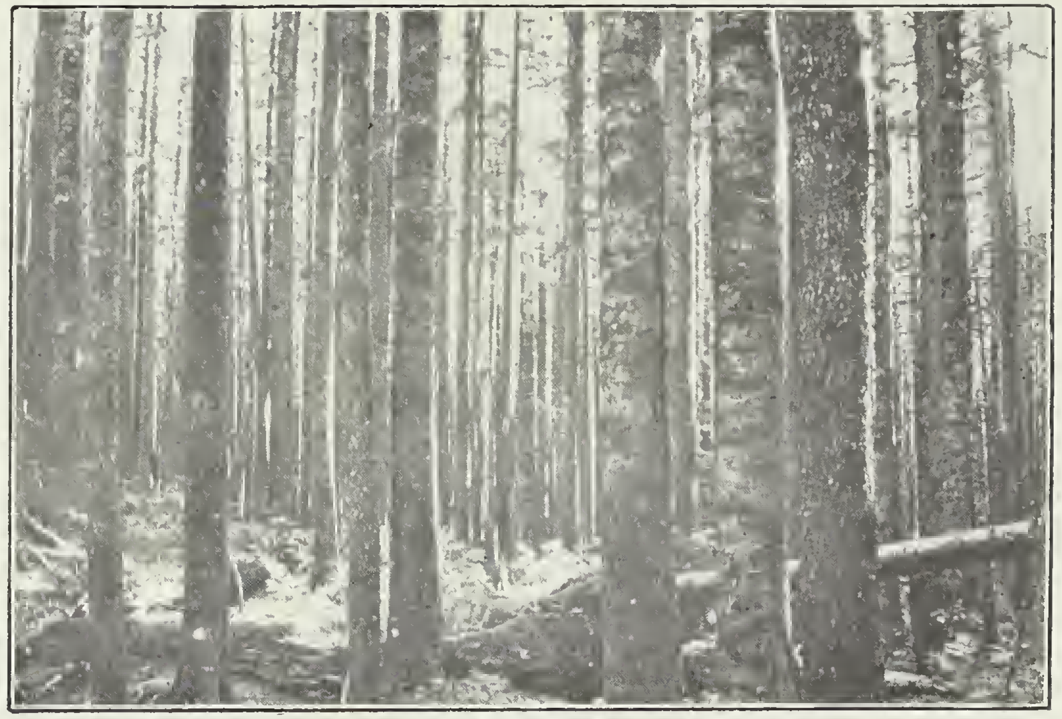
A. CEDAR TIMBER, BETWEEN OZETTE LAKE AND THE OCEAN BEACH.



B. HEMLOCK TIMBER, SEC. 32, T. 32 N., R. 14 W.



C. HEMLOCK TIMBER, SEC. 36, T. 32 N., R. 14 W.



D. HEMLOCK AND SILVER FIR TIMBER ON DIVIDE, SEC. 34, T. 32 N., R. 14 W.

The surface is very steep and broken in the northeast and southeast corners. The balance of the area is rolling, with level bottom land along the Suez River The soil is a clayey loam on the bottom lands, with red clay and sand on the uplands. The underbrush is very dense.

The timber on this township can all be logged to the Suez River. This has good banks and sufficient water in the winter season for driving logs, but as there is no harbor south of Cape Flattery on this coast it will be necessary to build a road of some kind from Neah Bay to the mouth of Suez River.

The hemlock and cedar timber in the east and south parts of this township are of good quality, but on the west they are very small and poor. The spruce timber is large and of good quality. It is found along the rivers and in the bottom lands.

Forest conditions in T. 32 N., R. 15 W., Washington.

Timbered area	acres	12, 800
Timbered bottom lands	do	1, 195
Total stand of timber	feet B. M.	579, 000, 000
Average stand per acre	feet	45, 234
Depth of humus	inches	4
Litter		Light.

Statistics of forest trees in T. 32 N., R. 15 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	221	......	......	......	......	......	......
Cedar	241½	107	42	24	10	30	210
Hemlock	78½	117	21	26	4	8	141
Spruce	38	175	45	50	2	5	191
Silver fir	579	150	32	41	2	4	161

TOWNSHIP 32 NORTH, RANGE 16 WEST.

This is a small fraction of a township, comprising parts of secs. 25 and 26 only, with a total area of less than one square mile, immediately on the Pacific coast. The surface is steep and rolling, with a sharp bluff on the coast line. The underbrush is very dense. The timber consists mainly of cedar, very large and of poor quality. It can be gotten out easily to the coast.

Forest conditions in T. 32 N., R. 16 W., Washington.

Timbered area	acres	640
Total stand of timber	feet B. M.	16, 500, 000
Average stand per acre	feet	25, 800

Statistics of forest trees in T. 32 N., R. 16 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Cedar	10	105	48	24	10	40	210
Hemlock	5	100	17	22	9	12	130
Spruce	1½	160	40	44	2	6	180

Township 33 North, Range 14 West.

This is a fractional township, bordering on the Strait of Juan de Fuca. It comprises secs. 19 and 28 to 35, together with fractional secs. 17, 18, 20, 21, 22, 26, 27, and 36, with a total area of approximately 14 square miles. The surface is steep and broken with many canyons, the land rising to a height of 1,060 feet. The soil is clay or sand. The underbrush is very dense everywhere.

The timber on this township can all be logged to the strait very cheaply by means of roads built up the creeks, but as there are no good harbors along this part of the coast it will be necessary to make small booms of the logs and tow them to some safe harbor up the coast.

The timber is chiefly hemlock and silver fir of good quality. The cedar though large is of inferior quality. The spruce timber, found merely along the strait, is excellent. The fir timber is found mainly in the southern part and is of excellent quality.

Forest conditions in T. 33 N., R. 14 W., Washington.

Timbered area	acres	8,960
Total stand of timber	feet B. M.	395,750,000
Average stand per acre	feet	44,200
Depth of humus	inches	3
Litter		Medium.

Statistics of forest trees in T. 33 N., R. 14 W., Washington.

Trees.	Stand.	Height.	Diameter.	Clear.	Dead.	Diseased.	Age.
	Million ft. B. M.	*Feet.*	*Inches.*	*Feet.*	*Per cent.*	*Per cent.*	*Years.*
Fir	7½	213	47	49	4	6	225
Cedar	20¾	115	48	30	9	28	218
Hemlock	236	138	29	33	4	8	155
Spruce	32	196	53	55	3	5	212
Silver fir	99½	154	34	41	3	6	167

CASCADE RANGE FOREST RESERVE, OREGON, FROM TOWNSHIP 28 SOUTH TO TOWNSHIP 37 SOUTH, INCLUSIVE; TOGETHER WITH THE ASHLAND FOREST RESERVE AND ADJACENT FOREST REGIONS FROM TOWNSHIP 28 SOUTH TO TOWNSHIP 41 SOUTH, INCLUSIVE, AND FROM RANGE 2 WEST TO RANGE 14 EAST, WILLAMETTE MERIDIAN, INCLUSIVE

BY

JOHN B. LEIBERG

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CASCADE RANGE AND ASHLAND FOREST RESERVES AND ADJACENT REGIONS.

By John B. Leiberg.

TOPOGRAPHICAL FEATURES.

The region discussed in this report consists of a tract of country in the southern portion of the State of Oregon, between longitude 121° and 123° west, and between latitude 42° and 43° 45′ north. It contains 4,676,360 acres. It comprises the central and upper areas of the Rogue and Klamath river basins, together with a small portion of the watershed of the Upper South Umpqua River.

The region is divided into two nearly equal portions by the main range of the Cascades, which strikes through it in an almost due north-south direction. The two regions thus formed, the western and the eastern slope, present many very dissimilar characteristics in their orographical and general topographical features.

REGION WEST OF THE CASCADES.

The orographical features of the region west of the Cascade Range are the backbone and lateral ridges of that range chiefly, supplemented in the southern areas by portions of the Siskiyou Mountains and their northward-projecting spurs, and in the northern districts by the Rogue River-Umpqua divide and its system of southerly laterals.

The Cascade Range is the principal mountain system. If we may judge from rock exposures in the region of the Upper Umpqua forks, the central core of the range is a broad, massive axis composed mainly of porphyry. It is, in most localities, overlain and capped by immense deposits of volcanic rocks, lava of various ages, pumice detritus, lapilli, and the like. Its summit from Diamond Lake, the northernmost point of the region included in this report, to the California line is, broadly speaking, a plateau-like area with a mean elevation of 6,000 feet. Its width varies from nearly 10 miles in the region south of Diamond Lake to 2 miles at the head of the Middle Fork of Rogue River, and to 4 miles a short distance north of Klamath Gap. The summit plateau is capped in many localities by rocky combs, or is broken by short, steep escarpments, while here and there rise from it volcanic cones whose fires have long since become extinct.

The slope stretching westward from the summit consists of a region with a mean elevation of 4,000 feet. Like the summit plateau of the range, it is covered mostly with volcanic rocks. It is not, however, a lava-covered region throughout, as is commonly believed. The western sections present many exposures of magnesian rocks and along the central areas of Dead Indian Creek these rocks are only very thinly covered by lava. The western slope is widely furrowed by the numerous canyons which form the Rogue River drainage system. The slopes of the canyons are usually steep and rocky, but, with the exception of the upper portions of the main Rogue River forks, the canyons are of no great depth. Irregular crests and ridges, generally of low elevation, separate the various canyons, which occasionally expand into flats. All of these flats have the appearance of having at some period been lake bottoms formed by lava streams which temporarily dammed the different drainage channels.

The entire tract here termed "the western slope of the main range of the Cascades" has a width of 35 miles. It rises abruptly, with a steep, bold front in the southern portion, and not so steep in the northern, from a depression which forms a sort of dividing line between the eastern terminations of the Coast Ranges and the Cascades. The depression is in the form of a valley 4 to 5 miles wide along Bear Creek, an affluent of Rogue River.

In the region under consideration the Cascade Range is cut in two by Klamath Gap. The gap is a narrow canyon through which the waters of the Upper Klamath region find their way to the ocean. In its canyon form the gap commences on the eastern side of the range at the point where Klamath River emerges from the marshes at the foot of Upper Klamath Lake. The upper portion of the canyon, which is all that comes within the scope of this examination, consists of a narrow trough varying from one-third to 1¼ miles in width and is excavated through a lava formation which evidently here is of very great thickness. The slopes of the canyon are steep and rocky, and the bottom, in the upper portion of its course, is but little wider than the breadth of the stream. A few miles below the point where the canyon crosses the southern border of Oregon and enters California it attains a width of 2 miles or more. Klamath Gap is supposed to have been at some time a powerful factor in modifying the extensions of the flora of the Cascades and the Sierra, but the upper portions of the gap are much too narrow in many places ever to have formed an effectual barrier against floral migrations or extensions.

Orographically Klamath Gap separates the Cascade Range from the northward extensions of the Sierra Nevada. If the gap did not exist the southern Cascades might be viewed as constituting a portion of the Sierra system geologically as well as orographically. But so far as rock exposures permit us to form an opinion, it appears that the porphyry axis of the Cascades and the flanking deposits of magnesian rocks have their extensions in the Siskiyou Mountains and not in the Sierras across the gap.

The volcanic character of the Cascades has already been mentioned. The summit of the range from Mount Thielsen, near the south end of Diamond Lake, to the southern edge of T. 38 S., is dotted with numerous extinct volcanic cones. Some of them are imposing peaks, as Mount Thielsen, Union Peak, and Mount Pitt, the latter reaching a height of 9,760 feet, or about 4,700 feet above the plateau summit. Other cones, mostly unnamed or locally known generically as "goosenests," attain elevations of 500 feet to 1,200 feet above the general summit level of the range. The cones and peaks present various aspects. The smaller ones, which are the most symmetrical in appearance, are usually truncated cones with a comparatively shallow central depression. Others, like Mount Scott and Mount Pitt, present a symmetrical outline when viewed at a distance, but are found to be of rough and irregular shape on close inspection. The more elevated cones and peaks have been subject to moderate glacial erosion, sufficiently intense, however, to modify materially the original outlines of the cones. Some appear to have had their vents lateral from the first, in others, toward the later periods of their existence, fresh craters or fissures opened far down on their slopes and as a result huge masses of the cone were blown out.

The cones and peaks are also of different ages. As one center of activity died out another arose some distance away. Some of the cones are extremely ancient, their fires quenched ages ago; others appear to have ejected volcanic material until within comparatively recent times, geologically speaking. From the difference in erosion between the two classes we may conclude that the smaller and better preserved ones are the younger, and that the larger and more eroded peaks are the more ancient. It is certain, however, that within recent geologic times, after a long period of quiescence, several of the larger and older centers of volcanic activity in the range suddenly broke out and sent forth great quantities of remarkably rough, highly vesicular lava. Especially noteworthy in this respect are Mount Pitt and Mount Brown, the latter situated about 4 miles south-southeast of the former. Surrounding their bases, and in the region between them, are large areas covered with the rough vesicular type of lava alluded to which has been so recently emitted that as yet no vegetation, except lichens and mosses, has obtained foothold on the rough and barren surface of the flows.

One of the most remarkable of the volcanic centers in this region is in T. 34 S., R. 5 E. It consists of five craters grouped around a common center and covering an area of 18 square miles. Its igneous activity ceased ages ago, but while in operation there were emitted from its craters vast masses of a homogeneous type of lava which flowed in all directions. It is one of the most ancient igneous centers in this portion of the range.

Several of the extinct volcanoes now contain lakes in the former craters. Such is the case in the locality mentioned above, but famous above all others in this respect stands Crater Lake. This lake occupies a deep depression on the summit of the range, nearly circular in outline, hence crateriform. The depression is supposed to be due to the subsidence of a large peak or cone which formerly existed here, or to the rending asunder and subsequent violent depression of the peak by volcanic eruptions of great energy.

The ejecta from the volcanoes have been of three general classes, namely, lava of various compositions, pumice, and lapilli or small fragments of rock which lack the coarsely cellular structure of the pumice. Much of the lava has apparently come from fissures, but the pumice and lapilli have been forced out through crateriform openings. In the category of ejecta must also be classed the large quantities of brecciated lava which occur plentifully throughout the volcanic areas of the western slope. This material can not be traced to any crater, but appears to have been forced out through fissures in a thick plastic state. In its course to the surface angular fragments of rock were torn from the fissured strata through which it was forced. These angular pieces of hard rock projecting from the surface of the lava by reason of unequal weathering make these brecciated masses conspicuously rough and uneven on their surfaces. While nowhere comprising a very large area they occur in so many localities that their aggregate acreage is considerable. Remarkably hard and barren, and usually entirely devoid of soil covering, these breccias do much toward thinning the average forest stands in the regions where they occur.

The character of the lava ejected by the proper volcanic vents varies greatly. The older lavas usually are hard and massive, but in some localities exhibit a short, irregular, thin slaty cleavage. The more recent lavas, on the other hand, are extremely rough and vesicular. Between the two extremes are found innumerable modifications.

The surface of the pumice deposit varies from a fine, almost ash-like detritus, to coarse angular fragments a foot or more in diameter. Enormous quantities were ejected from every vent on the range north of the southern boundary of township 34, burying deeply the summit and immediate slopes. The pumice deposit extends westward about 18 miles from the summit of the range. It is, and has been, of importance in many ways. It has filled up the crevices and smoothed out the asperities of many of the lava fields. It has filled the bottoms of many of the valleys, and has made large, level, and comparatively fertile flats where otherwise would have been a narrow, rocky trough. As a water sponge its present importance is very great. South of Union Peak the pumice is more or less mixed with lapilli, consisting of porphyritic rocks. These lapilli appear to have been blown out partly through the vent in that peak, and partly through a number of smaller cones situated between Union Peak and the head of the Middle Fork of Rogue River. Many of these lapilli are so little altered by their passage through the throat of a volcano, that the iron sulphides, which they contain in great abundance, have not even been desulphurized. The lapilli are exactly similar to the porphyry dikes which are found, uncapped by lava, throughout the region of the headwaters of the South Umpqua River, 30 to 40 miles northward.

South of the Middle Fork of Rogue River the pumice deposits cease or become very thin and scattering. The crest of the range is a mass of rough, uneven lava flows, in some places slightly smoothed over by deposits of lapilli, which take here the place of the pumice detritus farther north. The part played by the pumice in smoothing the asperities of the lava can nowhere be seen to better advantage than in the marked contrast offered by the Cascades summit outside and within the pumice-covered area.

Almost the entire drainage of the western slope finds its way into Rogue River. The exceptions consist of a few small streams, mere creeks, in the southern areas, which flow into Klamath River.

The chief forks of Rogue River are the North, the Middle, and the South. The affluents which form the North Fork head partly in the Rogue River–Umpqua divide and partly in the Cascades between Mount Thielsen and Union Peak. The tributaries of the Middle Fork head in the region between Union Peak and Klamath Point, while those which form the South Fork rise on the slopes of the broad platform which skirts the base of Mount Pitt on the north, west, and south. A large portion of the drainage from the extreme southern areas finds its way into the main river direct through Bear Creek, Indian Creek, the Big Butte Creek systems, and various lesser tributaries.

The canyons of the North Fork which head in the Cascades rise in ridges deeply covered with pumice and in flats which are sometimes grassy and marshy. Many of the canyons are deeply excavated in the soft and easily transported pumiceous material. In late years extensive forest fires have greatly accelerated the cutting process, which in time will doubtless transfer most of the pumice covering of the western slope of the range to lower levels. Although composed of such soft and loose material the slopes of the canyons in the pumice belt stand at a remarkably high angle, so much so that in many localities they offer an impassable barrier. The main stream of the North Fork runs through a valley which varies in width from three-fourths of a mile to 3 miles. Primarily, it is not a valley due to erosion, but it was formed by the direction and position assumed by the different lava flows which have covered the region. A long time ago a large portion of the depression in which the stream now flows was a lake, made so by a huge lava dike crossing the valley near the southwest corner of T. 32 S., R. 3 E., and the northeast corner of T. 33 S., R. 2 E. In this lake a mass of pumice was deposited, which smoothed out the inequalities of the original surface of the depression. In process of time the overflow from the lake cut through the dike, leaving a series of rapids and falls behind. The river began to excavate its channel through the pumice material, cutting a trough, which at the present time is 350 to 400 feet in depth and is marked by five to six terraces. As the river has eroded its bed, various lava dikes and inequalities of the ancient bottom of the valley have become uncovered. These have given rise to peculiar and interesting narrowings of the stream. Thus in T. 30 S., R. 3 E. the entire volume of the river, 150 to 250 feet in width and having a depth of 7 to 9 feet, in the early summer stage of flow, is forced through a rocky cleft 5 to 6 feet in width. Similar places occur in the channel of the stream in T. 31 S., R. 3 E. The falls and narrowings in the North Fork of Rogue River form insuperable obstacles to log driving.

The canyons of the Middle Fork head partly in pumice-covered tracts, partly in rocky glaciated areas. There commonly exists at their heads one or several small marshy or sedge-covered glades. Three principal tributaries form the Middle Fork. The one farthest south heads in a group of small lakes; the middle one has its rise in a series of large springs, numbering several hundred, which suddenly burst out from under a lava cliff. The character of the canyons of these tributaries of the Middle Fork is determined mostly by the position and thickness of the adjacent lava flows. For example, in the case of the southern affluent of the Middle Fork the canyon wall south of the stream is formed by a steep ridge of lava, which rises 1,800 to 2,000 feet above the stream, while on the north the canyon wall is a series of low, rocky terraces, ending in wide flats or in low ridges of easy slope. The main channel of the Middle Fork lies across a level, or nearly level lava sheet. The stream has made a clean cut 400 to 500 feet in depth through the lava, forming a canyon of this depth with nearly perpendicular slopes. The channels of the Middle Fork and its affluents are littered with large bowlders, and are broken by falls and rapids near their heads, rendering them unsuitable for log driving.

The drainage system of the South Fork of Rogue River consists chiefly of one large canyon which heads in the northern base of Mount Pitt. It is narrow and rocky throughout its entire length, and is deeply sunk between steep, rough lava flows. Near its head the canyon widens in a few places and contains several lakelets, one of which is 1½ miles in length and 350 to 400 yards in width.

Among the streams which flow directly into the main channel of Rogue River the Big Butte and the Little Butte are the most noteworthy. The former heads in the western and southern areas of the base of Mount Pitt. Its various tributaries are fed by large springs which issue from beneath the lava fields that surround the peak. Its course lies partly through canyons which here, as elsewhere in the region, are fashioned, as to their depth and character of slope, more by the configuration of the inclosing lava flows than by the effects produced by stream erosion, and partly through series of broad flats, which furnish good grazing and agricultural facilities.

Little Butte Creek heads partly in the southern base of Mount Pitt, and partly in a series of large flats in T. 37 S., R. 3 E. The largest of the northern affluents has as its reservoir Fish Lake, a shallow sheet of clear, cold water 4 to 5 feet in depth, 2 miles in length, and 400 to 500 yards in width. Its water level, apparently not subject to much variation, is maintained by huge springs in the northeast corner, which issue from under the mass of recent lava between Mount Pitt and Mount Brown. The outlet of Fish Lake is through a narrow bottom inclosed by banks 75 to 80 feet in height. It could readily be transformed into a large reservoir. Little Butte Creek, although a small stream, is of importance from the circumstance that its waters are largely diverted for purposes of irrigation in the Rogue River Plain.

The drainage which reaches Klamath River from the southern areas flows mostly by way of Spencer and Jenny creeks, both small streams of little importance.

Portions of the summit of the range and the western slope owe some of their topographic features to glacial erosion. In the pumice-covered areas glacial action was either feeble or altogether wanting, except on the highest summits, or the effects of glaciation, if it did occur, are hidden under the pumice. Where the pumice thins out, a few miles south of Klamath Point, the evidence of glacial action is more apparent. The summit of the range and the eastern slope present here the most conspicuous evidences of the presence of glaciers. On the western slope the evidence is much more apparent. The ice tore out the rims of many of the craters and scooped out many little depressions in the broad lava field which lies between Mount Pitt and the head of Cherry Creek, on the eastern side of the range. These depressions have filled with water and now are lakes. In other places the ice flowing down from the summit of the range excavated deep channels on the eastern side and spilled its load of drift blocks and gravel at the mouths of the canyons opening on the edges of Upper Klamath Lake. But, on the whole, with the exception of the region centering around the group of five craters previously described, glacial erosion was feeble throughout the Cascades in this region. It is difficult to understand why glaciation was so much more active in the region contiguous to this group of craters than elsewhere. The thickness of the ice sheet here must have been many hundreds of feet, and it must have existed for a long time. In its descent to lower levels it excavated a channel 1,000 feet in depth, which now forms the canyon of Cherry Creek. All of the rocks over which it passed are deeply marked with straight, broad grooves.

SISKIYOU MOUNTAINS.

The area of the Siskiyou Mountains described in this report comprises 400 square miles, the greater portion of the range lying outside the limits of the present examination.

Orographically the range forms a connecting link between the Coast Ranges and the Cascades. In T. 40 S., R. 3 E., it swings out from the Cascades in a westerly direction with a narrow, sharp curve, its porphyries and serpentine rocks coming to the surface from beneath the lavas of the western slope of the Cascades. The inner or northerly curve of the range presents a bold, steep, terraced front. The outer or southerly curve slopes away with a more gradual descent toward the Klamath Valley.

Where it leaves the Cascades, the crest line has an elevation of 5,200 feet. It is here a narrow backbone flanked by regions of extremely irregular surface. Sharp, narrow ridges set off by conical elevations and alternating deep saddles, with numerous intersecting ravines and canyons, constitute the relief of the upper slopes of the range in this locality. In T. 40 S., R. 1 E., the crest line rises to a height of 7,662 feet in a rocky elevation known as Siskiyou Peak or Ashland Butte, a prominent landmark for the surrounding region.

From Siskiyou Peak westward the summit of the range is narrow, seldom widening to 400 yards, often a mere hogback a few feet in width. The northern slope for the first 2,000 or 3,000 feet from the summit is steep and abrupt, and the southern slope differs but little in its gradients. The central mass of the range here, as where it leaves the Cascades, is composed of old eruptive and metamorphosed rocks, porphyries, serpentine, and granites. The lowest northern slopes are largely made up of talcose slates having a thinly laminated structure and resting on granites and porphyries. The volcanic cones and vents and the great lava flows and pumice deposits which are the predominant features in the geology of the Cascades in this region are absent from the Siskiyou Mountains.

The streams flowing from the range lie in deep canyons whose origin appears to be due chiefly to the erosive powers of water and ice.

A. SUMMIT OF SISKIYOU MOUNTAINS, NEAR STERLING PEAK

B. SUMMIT OF UMPQUA DIVIDES, LOOKING NORTHEAST FROM ABBOTS BUTTE.

Most of the larger canyons present clear evidences of the former existence of glaciers. Especially is this the case with the upper portion of the canyons which head in Sterling Peak, where the streams have not yet removed or smoothed out the lateral and terminal moraines which roughen the bottoms of the valleys (Pl. LXXIII, *A*).

The streams usually rise in grassy glades; at least such is the rule with those that head in the main range. Most of the glades are small in extent; but a few of those which form the heads of the larger afluents of Beaver and Humbug creeks, on the southern slope, each contain several hundred acres.

The canyons which drain the northern slopes occasionally widen in their lower portions and afford considerable tracts of agricultural and meadow land.

In this region the northern spurs of the Siskiyous stretch northward to a distance of 20 miles from the main range. They parallel the steep front of the western slope of the Cascades, from which they are separated by a strip of semiarid valley consisting of the basin of Bear Creek, a tributary of Rogue River.

UMPQUA MOUNTAINS.

The Umpqua Mountains comprise a wide strip of rough and rugged country between the Rogue and Willamette rivers, and form the drainage basin of Umpqua River. The examination extended only to a portion of the system which forms the divide between the upper reaches of the Rogue and South Umpqua rivers, comprising 350 square miles.

The divide, so far as the examination went, consists of a porphyry axis branching out from the Cascades in T. 28 S., R. 5 E., a little north of the south end of Diamond Lake, an extinct volcanic cone known as Old Bailey Mountain marking the point of departure. Its course is in a general westerly direction. Here and there, along the crest and flanks of the divide, the porphyries, more or less altered by volcanic heat, come to the surface. Generally, however, the more ancient rocks are covered up by deposits of the more recent Cascade lavas, but the blanket of lava is not so thick as along the western slope of the Cascades, except near the angle of junction with this range. Most of the deposits of lava appear to have flowed from local fissures, except where the divide joins the Cascades. At this point volcanic cones, similar to those which occur elsewhere in that range, make their appearance.

The summit of the divide is in most places a narrow crest, a mere hogback a few feet in width. Abbots Butte is, however, an exception. This elevation is situated directly on the main divide, but instead of being a narrow crest it is a broad, terraced volcanic mass level on its summit. Alternating deep saddles, where streams head and flow in opposite directions, and high, rocky, precipitous elevations make up the crest line (Pl. LXXIII, *B*).

The streams flowing from the range lie in deep canyons. Near their sources the slopes are steep and frequently nearly perpendicular. At the heads of the larger streams usually are small glades, while narrow stretches of level land exist here and there along the lower courses of the canyons, particularly along those which flow into Rogue River.

The general basin of the South Umpqua is a broad east-west depression, with its bottom consisting of a multitude of small canyons and comparatively low ridges, the whole inclosed between high, rough dividing ranges. The landscape is remarkably different from that which characterizes the drainage basins elsewhere on either slope of the Cascades in this region. On viewing it in its entirety one receives the impression that the area constitutes one of the primal drainage basins in the Cascades, one which was not affected by volcanic outbursts to the same extent as were the other adjacent areas, but remained comparatively free from the great outpourings of lava which so often in the past changed the aspect of other areas on the western slopes of the Cascade Range.

REGION EAST OF THE CASCADES.

The eastern slope of the Cascades presents a sharp contrast to the features which distinguish the western declivities of the range. This is mostly due to the abrupt rise of the mountains and consequent shortness of slope. From T. 36 S. northward to the extent of the present examination the distance from base to summit of the range in an air line is from 6 to 10 miles, as compared with a general average of 30 miles on the western side. South of township 35 the main range is separated from the plains' level by a short intermediate mountain mass of volcanic origin, which fills Ts. 37, 38, and 39 S., R. 6 E., with a great number of rough and rocky ridges.

The declivities of the eastern slope are generally steep, rocky, and irregular, or somewhat terraced lava flows. North of T. 36 S. pumice deposits have smoothed out a great many of the lesser asperities. In T. 28 S., Rs. 6 and 6½ E., there is a broad, very gentle slope from the plains' level to the summit of the Cascades at the south end of Diamond Lake, forming one of the easiest passes in the range. The pass leads to the head of the North Fork of Rogue River.

The canyons on the eastern slope are of two general classes: (1) short and straight canyons, with abrupt slopes and descents; (2) longer canyons with an oblique direction in their relation to the course of the main range, where they possess a more easy and gentle gradient. The short and straight canyons are chiefly canyons of erosion. At their openings there is commonly piled up a mass of bowlder drift. The other variety consists of depressions due to the position and course taken by the inclosing lava masses in which the streams sometimes have cut deep secondary canyons and gorges. Anna Creek, in Ts. 31 and 32, R. 6 E., furnishes an example of the latter kind; while Threemile, Cherry, and Rock creeks, in Ts. 34 and 35, R. 6 E., are of the former type.

The region to the east of the Cascades forms, so far as our limits go, the upper drainage basin of Klamath River. The orographical features of the region consist of: (1) the Klamath-Deschutes divide; (2) many volcanic ridges of varying altitude, which are more or less connected, some of which intersect the basin in a north-south direction, while others intersect in an east-west direction.

The Klamath-Deschutes divide branches out from the Cascades approximately in T. 26 S., R. 7 E. It swings around to the southward and constitutes a span bridging Klamath Gap. The ridge is of volcanic origin, is extremely ancient, and may at some past time have been of much greater altitude. If so it would constitute a sort of highway for migrations of animals and plants from the northern Sierras to the Cascades, and vice versa.

The volcanic character of the ridges which intersect the Klamath drainage basin in this region has already been alluded to. Some of these ridges have been built up around volcanic vents, others are irregular masses whose origin perhaps is to be sought in earth fissures. The entire basin seems originally to have been a plateau area. The lava outflows inclosed many flats, which in time became lakes. Most of these lakes have been drained by their waters cutting channels through the lava dams. Others are in various stages from marshes to shallow lakes.

Extinct craters abound. Some formed parts of long ranges, or rather were the centers from which flowed long streams of lava. Such are Yamsay Peak, Swan Lake Point, Fuego Mountain, Yainax Butte, and various unnamed craters in the Black Hills. Others occur as isolated conical hills scattered throughout the region. Some of the lava flows which came from these vents spread out over the region in vast, flat sheets, others are heaped up in ridged and terraced masses. The igneous activity in the basin is not yet altogether quenched. The hot springs in the southern areas, which frequently lie in long lines, indicate that there are many pressure lines and fissures which are not yet closed.

The northern area and much of the central are covered with a layer of pumice. Some of the pumice came from vents in the Cascades, much of it was ejected from craters in the basin, notably from those in the Yamsay Range. Near the Cascades the pumice deposit undoubtedly is very thick. In the eastern and southeastern areas of the basin it is thin, in some places not more than 4 to 8 feet in thickness, much of it evidently having been washed away.

The plain or depression which stretches along the base of the Cascades in this region is comparatively narrow, varying from 10 to 15 miles in width. It consists of two distinct terraces, a northern and a southern, the former elevated about 400 feet above the latter. The terraces connect through the valleys of Williamson and Sprague rivers with the terrace or plain which borders the central areas of Sprague River. Through the valley of Sycan River the Sprague River terrace connects with the lesser level areas which form Sycan Marsh and adjacent regions. The connection between each of these terraces is invariably through a stretch of narrow canyon which represents a cut through a lava flow.

The southern terrace in front of the Cascades comprises the basins of Upper Klamath Lake with the adjoining marshes, together with a portion of Lower Klamath Lake and a level valley area along the lower portion of Lost River. This terrace contains 450 square miles and extends from the northern line of T. 33 S. to the Oregon-California line.

Upper Klamath Lake is mostly a shallow body of water. It is a lake chiefly because the lava flows at its foot and at the point near Plevna where Klamath River leaves the marshy areas have not been cut down sufficiently to drain the lake. If the falls in Klamath River were lowered a few feet the greater portion of Upper Klamath Lake would become dry.

The upper terrace is separated from the lower by a broad, thick lava flow, which stretches from northwest to southeast, and possibly may have come from Mount Scott or adjacent craters. The lava flow created a large lake, of which all that remains is Klamath Marsh, most of its area having been drained by the Williamson River cutting a canyon through the lava flow at a point 8 miles east of Fort Klamath. The upper terrace stretches northward to the Klamath-Deschutes divide. Eastward it extends to the foot of the Yamsay Range, which it follows southward along the western base to the head of Williamson River.

The pumice covering both on the upper and on the lower of these terraces was deposited when they were deeply covered with water. The present smoothness of their surface, only roughened by ancient beach lines along higher levels and by the courses of modern streams, proves this. Some of the pumice appears to have been thrown out as fine particles. Much of it came as large, coarse fragments or bowlders a foot or more in diameter.

The Sycan terrace is situated east of the Yamsay Range and has an elevation of 5,000 feet. It likewise was a lake in past geologic times. It was formed by a lava flow which came from a crater, now extinct, situated in the Fuego Range. Sycan River has cut through the obstruction, the lake has been drained, and a swampy tract known as Sycan Marsh now remains.

The Sprague River terrace consists of an area bordering Sprague River westward from the junction of its main forks. It covers an area of 260 square miles. As in the case of the other terraces, the Sprague River area was once a lake bottom. The lake owed its origin to a lava flow from the volcanic centers near Swan Lake Point. Much of this terrace has been denuded of its pumice covering and the underlying rough lava is brought to view or it is covered with gravel and small bowlders. The terrace is a semiarid region.

Here and there throughout the entire Upper Klamath Basin are scattered smaller terraces or flats more or less completely surrounded by thick lava flows. One of the larger is Swan Lake Valley. This is a level tract inclosed by lava flows which came from Swan Lake Point. It is remarkable for a thick deposit of diatomaceous earth, which underlies the entire flat at a depth of a few feet.

The higher points in the region show marks of light glaciation, but the terraces and flats show no clear evidences of the scoring or wearing effects of ice. Here, as in the Cascades, the smoothness of the pumice deposits proves either that glaciation preceded their deposition or that the region has not at any time been subject to the action of ice. The removal of the pumice down to the underlying lava on the Sprague and Sycan terraces is due to local effects of drainage.

The streams in the region flow mostly in shallow canyons. The exceptions are at the points where they have cut their way through lava flows stretching across their courses. Some of the streams, such as Sprague River, have excavated their beds to a depth of 20 to 80 feet below the general level of the terrace through which they flow, and have one or two narrow benches in their troughs to mark the stages of the erosive process. Owing to the volcanic nature of the region and the numerous fissures in the lava bed rock a great many of the streams flow irregularly. Many of them sink and disappear, only to be forced to the surface at some other point. Williamson River and, in part, Sycan River head in large springs which suddenly burst out with great force from under thick masses of lava of the Yamsay Range. Such is also the case with Crooked River and Fort Creek, streams near Fort Klamath, and with many other lesser creeks.

CLIMATIC CONDITIONS.

Broadly stated, the general climatic features, as regards precipitation, may be referred to two classes: first, areas with an abundance of precipitation; and, second, areas characterized by semiaridity, or a low ratio of rainfall. The former are characteristic of the western slope of the Cascades, the latter of the eastern, but the range is by no means a strict dividing line in all cases, as areas possessing either feature are found on both sides of the range.

Local conditions modify the precipitation. The chief of these exists in the relief of the region, and altitude is the more prominent factor here. We thus have on the western slope true semiarid conditions in the low-lying valleys, and on the eastern slope, at high elevations, decidedly humid ones. Both the western and eastern slopes may, therefore, be divided into semiarid, subhumid, and humid belts.

WESTERN SLOPE.

SEMIARID REGION.

Areas of this character occur here under two aspects: first, those naturally semiarid; and, second, such as have assumed this condition through the agency of man.

The first of these have their origin in the relief of the country, and possibly in slow climatic changes taking place over the entire western slope of the Cascades and connecting ranges along the coast. They are permanently semiarid, and, if the climatic hypothesis be true, they are gradually enlarging their area.

The second, induced through conditions created by the agency of man, probably are only of temporary duration.

The larger naturally and permanently semiarid tracts on the western slopes of the Cascades in this region consist of: (1) the area of depression situated between the spurs projecting northward from the region around Siskiyou Peak and the terminations of the western spurs of the Cascades; (2) the areas embraced in the lower and middle slopes on the western spurs of the Cascades, where they front on the above-described depression; (3) a considerable tract among the Siskiyou spurs fronting on North Fork of Applegate Creek; and (4) areas bordering Rogue River in Ts. 35 and 36 S., Rs. 2 and 1 W. and 1 E.

The annual precipitation on these tracts probably does not exceed 15 inches. They are all characterized by having a small amount of arboreal vegetation, mostly confined to the banks of the water courses. They carry scattered copses of black oak (*Quercus californica*) and white oak (*Q. garryana*), interspersed here and there by stands of frutescent or, rarely, arborescent madroña (*Arbutus menziesii*), and with dense thickets of brush largely composed of chaparral (*Ceanothus cuneatus*).

The lowest elevation of the semiarid tracts is approximately 1,600 feet. From this level the curve of semiaridity rises to a height of 4,000 feet on the terminal declivities of some of the western spurs of the Cascades, as, for example, on the southwestern slopes of the Grizzly Range north-northeast from Ashland, and to 4,800 feet on various of the Siskiyou spurs bordering Applegate Creek. Where the curve of semiaridity crosses the Siskiyou main range and connects with the semiarid region northwest of Mount Shasta, through canyons and over low ridges east of Pilot Knob, it rises to altitudes of 6,000 feet.

There are no points in this region where the semiarid tracts west of the Cascades join those situated east of the range. Not even through Klamath Gap is there a wholly uninterrupted connection; for Klamath Gap, where the river breaks through the orographic backbone of the Cascades, lies in a region that must be classed as subhumid at least.

The tracts on which a condition of temporary semiaridity has been artificially induced consist chiefly of old or recent burns in the forested subhumid areas. They are scattered over the entire slope, but are most numerous and of largest extent in Ts. 31, 32, 33, 34, and 35 S., R. 4 E., where they collectively cover an area of 50,000 acres. It is impossible to say with absolute certainty that the tracts just mentioned are semiarid as a temporary condition only. They are slopes and summits denuded of their forest covering forty or forty-five years ago through the medium of severe fires. They are now covered with brush growths composed of species characteristic of semiarid lands, and their aspect is exactly like that of the semiarid chaparral slopes of California. Areas having similar characters, but not so large, occur in Ts. 38 and 39 S., Rs. 4 and 5 E. There is at least an even chance that such tracts will not again reforest, in which event they will constitute evidence proving the northward advance of the arid conditions prevalent in the regions farther south.

SUBHUMID REGION.

The subhumid region includes the slopes and summits of the Siskiyou, Umpqua, and Cascade ranges, between elevations of 3,000 and 6,000 feet, with the exceptions detailed under semiarid tracts. The annual precipitation is unknown to me, and there are probably no data available as to the quantity. The forest growth indicates from 35 to 50 inches, according to elevation. The region is characterized throughout by forested areas with stands of timber varying from moderately heavy to dense.

HUMID REGION.

The humid region comprises slopes and summits above the 6,000-foot contour. The annual precipitation is unknown to me, but it certainly reaches considerably above 50 inches. The lower portions carry forests similar to those which occur on the higher tracts of the subhumid slopes; the higher bear subalpine growths of trees and other vegetation, with here and there a peak projecting above the limit of trees.

EASTERN SLOPE.

SEMIARID REGION.

The semiarid lands east of the Cascades in this region occur chiefly in the interior of the Klamath Basin. They just touch the eastern base of the range in Ts. 39 and 40 S., Rs. 8 and 9 E. They stand in intimate relationship with areas of like character south beyond the eastern Oregon border through various valleys and depressions, such as Lost River and its tributaries. Their extension northward ceases on the Sprague River terrace. They are characterized by the growth of various desert shrubs and by the occurrence of scattered small stands of western juniper.

With the exception of the tracts mentioned as occurring in townships 39 and 40, none of the areas at the immediate base of the Cascades can now be considered as truly semiarid. But the region comprised within the limits of the Klamath Marsh terrace shows decided tendencies in that direction. The leaning toward semiarid conditions is there shown by deficient reforestation of burned tracts in the lodgepole-pine stands, and the evident tendency of such places to become covered with a growth of desert shrubs or grasses in place of the former forest.

The semiarid tracts of the Klamath Basin east of the Cascades comprise in the aggregate, so far as they come within this region, 800 square miles. The annual precipitation is about 15 inches.

SUBHUMID REGION.

The larger portion of the area in the Upper Klamath Basin is distinctly a subhumid one. Without knowing the actual precipitation in the region, its actual status on this point is therefore more or less guesswork, but, judging from the density of forest growth, I would place it at the same horizon as in the areas between the 3,000- and 4,200-foot contours along the fronts of the western spurs of the Cascades—that is, 25 to 35 inches per annum. The subhumid condition becomes possible only by reason of the numerous ridges scattered throughout the basin, which give to much of it a mean altitude of between 5,000 and 6,000 feet.

The areas are characterized by extensive stands of forest of medium density with a vigor of growth not inferior to that possessed by similar stands west of the Cascades.

HUMID REGION.

The strictly humid areas are of small extent. They are limited to tracts along the main range of the Cascades and to the high peaks of the Yamsay and Gearhart ranges in the interior regions of the basin.

They are characterized by moderate, light, or very thin stands of forest of subalpine types and by the low, shrubby, and herbaceous vegetation belonging to tracts of high altitude in this region.

I have no temperature data for any portion of the region either west or east of the Cascades. None of the high peaks have a permanent snow line on all sides. On the summit of Mounts Pitt and Scott there is commonly some snow on the northern slopes throughout the year. Occasionally, deep drifts in shady ravines on the other slopes persist through the summer, but the rule is that southern and western exposures on even the highest peaks are free of snow during a portion of the year.

FOREST CONDITIONS.

SPECIES.

The forest is overwhelmingly coniferous. This is especially the case on the areas east of the Cascades, where broad-leaved species of trees form but a fraction of 1 per cent of the forest stands, and where two conifers, the yellow and the lodgepole pine, together constitute 88 per cent. West of the Cascades broad-leaved trees occur more plentifully, forming, on a numerical basis, about 6 per cent of the entire forest; and while among the conifers two species, the yellow pine and the red fir, particularly predominate, there is also a wider range of ratios among the balance than is found on the eastern side of the range.

The following species of coniferous trees form the sylvan elements, and in many and varied ratios and groupings make up the forests and its component types:

Coniferous trees in Cascade Range Reserve and adjacent territory, Oregon.

Yellow pine	Pinus ponderosa.
Sugar pine	Pinus lambertiana.
White pine	Pinus monticola.
White-bark pine	Pinus albicaulis.
Lodgepole pine	Pinus murrayana.
White fir	Abies concolor, including transitional forms to the northern Abies grandis.
Amabilis fir	Abies amabilis.
Noble fir	Abies nobilis.
Alpine fir	Abies lasiocarpa.
Red fir	Pseudotsuga mucronata.
Incense cedar	Libocedrus decurrens.
Alaska cedar	Chamæcyparis nootkatensis.
Western hemlock	Tsuga mertensiana.
Alpine hemlock	Tsuga pattonii.
Engelmann spruce	Picea engelmanni.
Pacific yew	Taxus brevifolia.
Western juniper	Juniperus occidentalis.

Among the various species of broad-leaved trees the following are abundant enough to become conspicuous factors in the forest:

Broad-leaved trees in Cascade Range Reserve and adjacent territory, Oregon.

California black oak	Quercus californica.
Pacific post oak	Quercus garryana.
Madroña	Arbutus menziesii.
Oregon ash	Fraxinus oregona.
Oregon maple	Acer macrophyllum.
Red alder	Alnus oregona.
Mountain mahogany	Cercocarpus ledifolius.
Birch-leaf mahogany	Cercocarpus betuloides.
Golden-leaf chinquapin	Castanopsis chrysophylla.
Oregon crab	Malus rivularis.
Aspen	Populus tremuloides.
Balsam	Populus balsamifera.
Black cottonwood	Populus trichocarpa.
Pale elder	Sambucus glauca.

In addition to the species enumerated there occur various kinds of willow, hawthorn, plum, and cherry.

In the sylva of the eastern and western side of the Cascades collectively, the broad-leaved trees constitute 6.5 per cent, on a numerical basis, including individuals with basal diameters of 4 inches and upward. On the western side, the oaks, madroña, and chinquapin, when estimated on a similar basis, form 5 per cent.

Although the broad-leaved trees show an appreciable percentage of the forest when estimated by their numbers, they sink into utter insignificance when the relative timber volume is compared with the coniferous growth. Owing to the circumstance that timber estimates have so far been made only on the basis of diameters and lengths suitable for mill timbers expressed in feet board measure instead of cubic contents, the broad-leaved species have been excluded from the estimates. It is, therefore, not possible to state in any but the most general figures the relative proportion in volume between the broad-leaved and the coniferous growths. From various data obtained in the cruisings during the current year I should place the relative proportion of the two divisions of the sylva in the ratio of 1 to 0.001, or, in other words, for every cubic foot of timber derived from broad-leaved species there are 1,000 cubic feet of timber of coniferous species. Were it not for the considerable oak and madroña growth on the low-lying semiarid and contiguous regions in the Middle Rogue River Basin the broad-leaved species would not show anywhere near so large a ratio. On areas situated within the middle and upper elevations and throughout the forested regions east of the Cascades the timber volume of species other than conifers is excessively small.

The following tables give the ratios between the different components which compose the coniferous forest. They are based upon numerical proportions and not upon the timber volume, and include trees with basal diameters of 4 inches and upward. The tables are compiled for the purpose of indicating the proportions of the elements forming the established forest growth at the present time, within the dimensions specified. The numerical status of a species in the early stages of growth is determined in this region by its environments as regards shade, and by the multitudinous modifications and departures from the composition of the original growth on areas undergoing reforestations after fires. The numerical proportion of the forest components is never, in this region, a fixed matter. The older the stands, the less change there is in their composition up to a certain age limit, which varies with the life factor in the general duration of the species. For this reason were we to adopt a higher or a lower standard than 4 inches it would very materially change the proportions of the different species.

Relative proportions of coniferous species forming the forest on the western slope of the Cascades.

	Per cent.		Per cent.
Yellow pine	27.5	Noble fir	5.8
Sugar pine	2.8	Alpine fir	.2
White pine	.36	Western hemlock	.1
White-bark pine	.03	Alpine hemlock	6.5
Lodgepole pine	6.3	Engelmann spruce	.6
Red fir	44.	Incense cedar	.41
White fir	5.4		

Amabilis fir and Alaska cedar are two species which occur in the region, but are so few in numbers that they are quite inappreciable in the bulk of the forest.

From the above table it will be seen that two species, yellow pine and red fir, together constitute 71.5 per cent of the coniferous forest. It is generally supposed that the red fir is greatly the superior of all other species in this region. The contrary, however, is the case, the excess over the yellow-pine component being only 16.5 per cent. The cause lies entirely in the oft-repeated forest fires which sweep through these wooded areas. The seedlings and young trees possessing the greatest fire resistance survive, the others die. In its capacity to endure fire and survive the yellow pine is greatly the superior of all the other conifers in this region.

The large ratio of lodgepole pine is wholly owing to extensive fires in the subalpine areas, which have destroyed large and dense growths of alpine hemlock and noble fir, and have induced soil conditions exceptionally favorable to reforestation by lodgepole pine.

Sugar pine, white pine, Engelmann spruce, and incense cedar are species which have an extensive range, but do not reproduce themselves abundantly; hence the low ratio.

White-bark pine, alpine fir, and western hemlock are trees whose range is circumscribed. The two former belong to the upper limit of the subalpine areas; the latter is of scattered occurrence in a few favorable localities, apparently, in this region, being near its southern limits.

Relative proportions of coniferous species forming the forest on the eastern slope of the Cascades.

	Per cent.		Per cent.
Yellow pine	68.	Noble fir	.5
Sugar pine	.9	Alpine fir	.02
White pine	.05	Western hemlock	Lacking.
White-bark pine	.01	Alpine hemlock	1.
Lodgepole pine	22.6	Engelmann spruce	.25
Red fir	1.22	Incense cedar	.75
White fir	3.7	Western juniper	1.

It will be noticed that the yellow pine easily ranks above all of the other species either singly or combined. The reason for this lies chiefly in the smaller annual precipitation on the subhumid areas of the western slope. The large proportion of lodgepole pine is chiefly due to forest fires. At least 90 per cent of the species owes its growth to this cause. The remainder occurs as the first forest covering on areas gradually being laid bare along margins of marshes and lakes by the lowering of their waters.

GEOGRAPHICAL DISTRIBUTION OF SPECIES.

With the exception of amabilis fir and Alaska cedar all of the conifers of the western slope are also represented on the eastern side of the Cascades; nor are they confined to the immediate eastern declivities of the range. With the exception of alpine hemlock, western hemlock, noble fir, and Engelmann spruce, they are found at many intermediate points between the Cascades and the Klamath-Deschutes divide, and it is not at all unlikely that further explorations may discover the four missing species on some of the subalpine elevations along that divide.

The yellow pine is the most widely distributed of the species. Occurring everywhere throughout the western slope within its altitudinal limit, it crosses the Cascades in a broad belt through Klamath Gap in Ts. 39 and 40 S. and in narrow scattered groves or in thin lines south of Lake of the Woods, in Ts. 38 and 37 S., following to Pelican Bay of Upper Klamath Lake the depression which exists between the Cascades main range and the group of high mountains west of Aspen Lake. Having reached the eastern base of the Cascades, the species follows the foot of the range northward to the southern boundary of the Klamath Marsh terrace, whence in a broad sheet it spreads out over the entire Upper Klamath Basin.

The sugar pine is more restricted in its range. Confined on the western slope within narrower limits than the yellow pine, it crosses the Cascades through Klamath Gap. The distance between its eastern and western extensions in the Lake of the Woods depression is not more than 10 miles, and it is not impossible that scattered trees may occur in the short interval that separates the two. From where the sugar pine enters the Upper Klamath Basin through the gap it continues to extend northward, following closely the foot of the range and the lower edges of its middle elevations. In T. 33 S. it meets a southward extension coming from the Deschutes Basin. Heading the terrace of the Klamath lakes in T. 32 S., the sugar pine turns toward the south and follows the broken lava plateau which joins the volcanic areas around Swan Lake Point with those in the Cascades southeast of Mount Scott. A few miles southeast of Swan Lake Point the sugar pine thins out and disappears. Its next appearance in the Klamath Basin, within this region, is on the slopes of the Yamsay Range. It is here an offshoot from the mass of sugar pine which closely hugs the Klamath-Deschutes divide from its junction with the Cascades to some point in northern California outside of the area under consideration. From the Yamsay Range the species takes a southerly course to the region around Fuego Mountain in T. 33 S., and turning toward the east it becomes abundant enough to be reckoned as a factor in the mill-timber supply on the areas around the Black Hills in T. 34 S., Rs. 12 and 13 E. Continuing eastward it joins the stands of the species on the Klamath-Deschutes divide in the region of Gearhart Mountains.

The white pine is not a tree of plentiful occurrence on the west side of the Cascades. Beginning with the Siskiyou Mountains, it is found here and there on the higher slopes between Siskiyou Peak and Sterling Peak. Between its habitat here and its range in the southern areas of the Cascades is a wide gap. In the upper region of the basin of the South Umpqua the species is relatively abundant. From here it continues southward along the flanks of the Cascades, rarely extending more than 14 miles west from the summit, to the northern boundary of T. 39 S., R. 5 E., where it thins out and disappears. It crosses the Cascades in many localities between Diamond Lake and its southern limit in township 39, and extends down the eastern slope to the 5,000-foot contour line in many places. It is not found in the region of the Upper Klamath Basin within this area, but a few miles to the east in the Gearhart Mountains the species again appears.

The white-bark pine, being strictly a species of the upper limits of the subalpine areas, has a wide range, but is confined within narrow altitudinal limits. In the Siskiyou Mountains the species is nearly absent. A few score individuals in a group between Siskiyou Peak and Sterling Peak constitute all that were seen. Along the Umpqua-

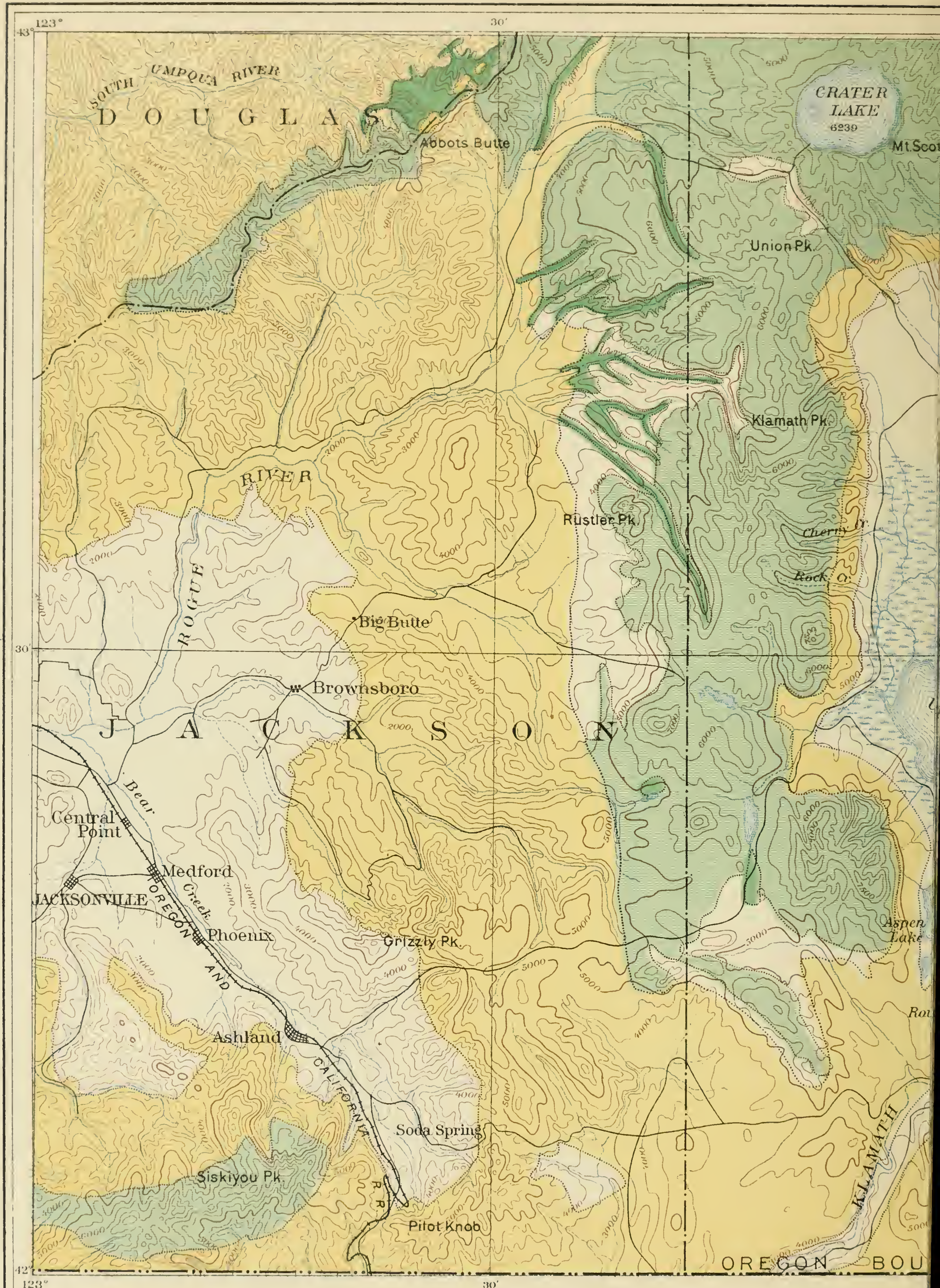
Rogue River divide a few individuals were observed on the highest summits. The region of its greatest density is along the summit of the Cascades, where it forms the true timber-line tree on peaks like Mounts Pitt and Scott at elevations of 9,400 to 9,500 feet. In the interior of the Upper Klamath Basin it occurs on Yamsay Range and on high ridges in the Klamath-Deschutes divide.

The lodgepole pine is a species with a range which extends throughout the entire region examined. Strangely enough, it is not very plentiful either in the Siskiyou or in the Umpqua Mountains except where the latter range joins the Cascades. Its chief habitats are on the higher and summit areas of the Cascades, where it forms a very large proportion of areas reforested after fires, and everywhere in the interior of the Upper Klamath Basin, except on distinctly semiarid tracts.

The red fir is abundant on the western slopes of the Cascades, in the Siskiyou Mountains, and in the Umpquas between elevations of 2,500 and 6,200 feet. Below the 2,500-foot contour the growth is thin and scattering, but the species is never wholly lacking over any considerable area outside the distinctly semiarid, low-lying tracts. It crosses the Cascades through Klamath Gap and through the depression south of Mount Pitt in T. 36 S. On the eastern side of the Cascades it follows the foot and lower slopes of the range northward to the southern edge of the Klamath Marsh terrace. Here the growth is thin, the species occurring as low, gnarled individuals widely dispersed among the masses of yellow pine. The species does not extend northward from this point, but heading the north end of Upper Klamath Lake and turning eastward it follows the higher lava flows southward to the region around Swan Lake Point. On the eastern slopes of this peak the tree is fairly abundant, but of small dimensions. It thins out and disappears completely 4 miles south from Swan Lake Point, but reappears on the divides at the head of Lost River. It is not found elsewhere in the interior of the Klamath Basin, nor do I know of its occurrence on the Klamath-Deschutes divide.

The white fir occurs throughout all of the areas examined west of the Cascades below the 6,000-foot contour line. It crosses the range in many places between the canyon of Klamath River and Mount Pitt, but scarcely north of this peak. On the eastern slope it follows the range toward the north, and beyond the head of Upper Klamath Lake it spreads out over the entire forested area of the Upper Klamath Basin above elevations of 5,000 feet.

The noble fir is a species with its home chiefly among the higher elevations. It reaches its greatest dimensions at the lower levels of the subalpine forest. Within its proper altitudinal limits the species occurs everywhere on the areas west of the Cascades. It crosses the range freely, except in Klamath Gap, and on the eastern slope extends from 2 to 6 miles from the summit. The species is absent from the ranges in the interior of the Upper Klamath Basin.



PART OF SOUTHERN OREGON SHOWING DISTRIBUTION OF

Prepared under the direction of

BY JOH

🟨 Sugar pine

🟩 Noble fir

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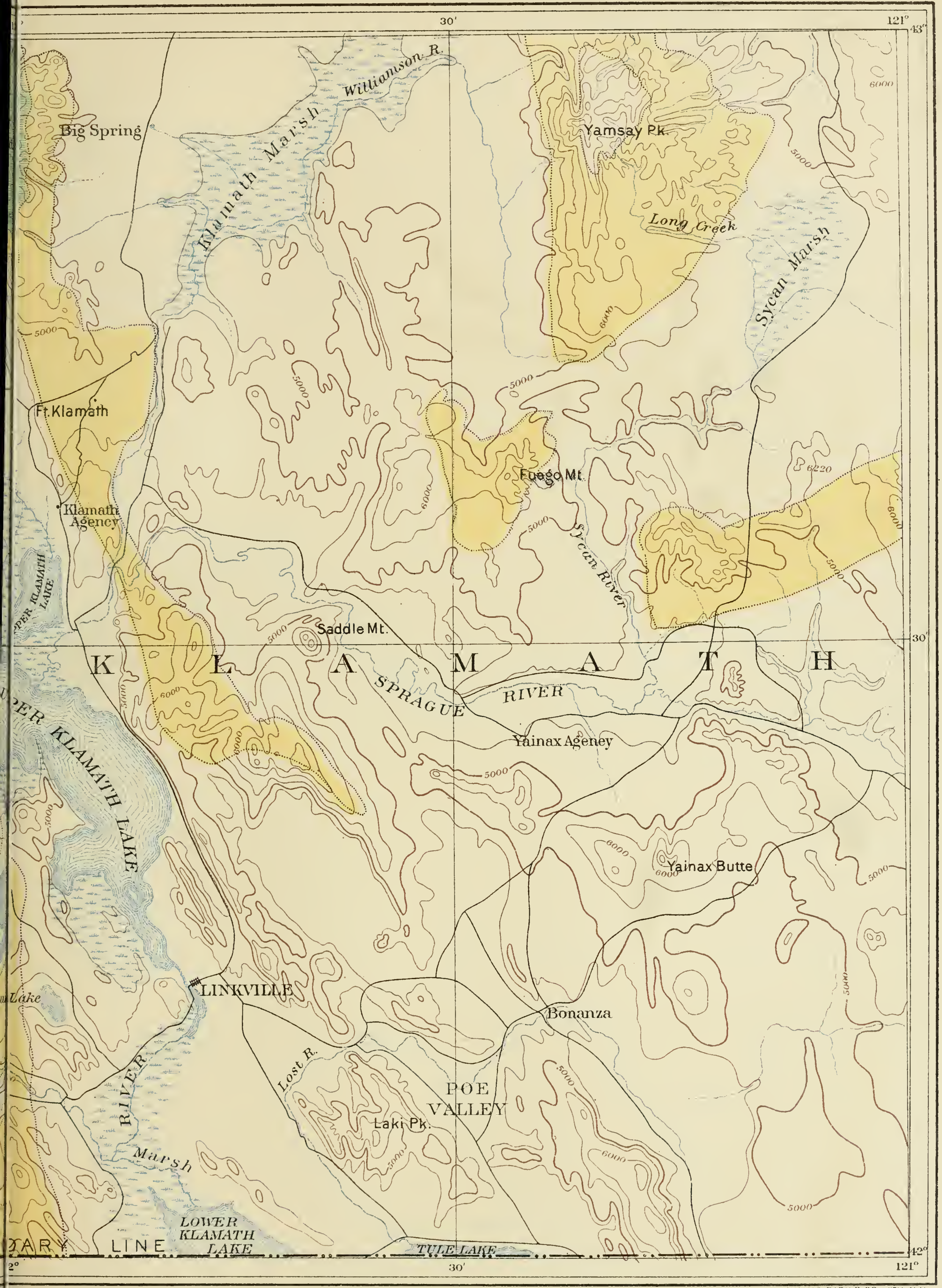

JULIUS BIEN & CO. LITH. N.Y.

GAR PINE, NOBLE FIR, WESTERN HEMLOCK, INCENSE CEDAR

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🟩 Western hemlock

🟨 Incense cedar

The alpine fir is a tree of the high altitudes, and therefore is chiefly confined to subalpine areas. It occurs plentifully everywhere on the summit of the Cascades, less so on the Umpqua-Rogue River divide, while on the Siskiyou Mountains, so far as examined, it is nearly absent. I have no knowledge of its occurrence east of the Cascades in this region, except on the immediate declivities of the main range.

The western hemlock is found on the western side of the Cascades in scattered localities from Mount Pitt to Mount Thielsen, but nowhere very abundant. It is more plentiful on the northern slopes of the Umpqua-Rogue River divide than elsewhere. It is absent from the Siskiyou Mountains. In the region around the southern base of Mount Pitt scattering trees of the species cross over to the eastern side of the Cascades and form a small percentage of the forest at the south end of Lake of the Woods. The species is lacking in the Upper Klamath Basin.

The alpine hemlock is extremely abundant along the higher elevations of the Cascades and on the Umpqua-Rogue River divide. It freely crosses to the eastern side of the Cascades except through Klamath Gap, where the elevation dips below its altitudinal range. It is absent from the Siskiyou Mountains, so far as explored, with the exception of the northern slopes of Siskiyou Peak, where a few score individuals of the species were noticed. I have no knowledge of its occurrence anywhere in the interior of the Upper Klamath Basin, but there is a probability, at least, that it may be found along the highest points of the Klamath-Deschutes divide when that region shall have been explored.

Of the spruces, the only species represented in this region is Engelmann spruce. The tree is found in scattered bodies, mixed with other species, along the summit and in the canyons of the Cascades, both on the eastern and western slopes of the range. It is lacking in Klamath Gap for no apparent reason, as its altitudinal limit on the eastern side of the range is several hundred feet below the highest point in the gap. The species is lacking in the Siskiyou Mountains and on the Umpqua-Rogue River divide.

The incense cedar occurs in moderate abundance throughout the region of middle elevations on the western side of the Cascades, in the Siskiyou Mountains, and on the Umpqua-Rogue River divide. It crosses the Cascades through Klamath Gap, extends northward along the foot of the range to the Klamath Marsh terrace, whence it spreads out over the entire forested region of the Upper Klamath Basin.

The western juniper is of rare occurrence west of the Cascades in the Rogue River Basin. It is lacking on the Umpqua-Rogue River divide, likewise on the northern slopes of the Siskiyou Mountains, but is fairly common at low elevations on the southern declivities. East of the Cascades it occurs throughout the semiarid region comprised in the Sprague River terrace, on the thinly wooded tracts at the eastern termination of Klamath Gap, throughout the semiarid regions of the Lost River drainage, and, in general, where the annual precipitation falls below subhumid ratios.

Among the broad-leaved species of the forest the most conspicuous are oak, madroña, and chinquapin. The two former are confined to the western slope of the Cascades; the latter occurs on both the eastern and western declivities, crossing the range in the region south of Mount Pitt. It is present along the Klamath-Deschutes divide, but only in a shrubby form or variety.

In the geographical distribution of the coniferous sylva as outlined above, Klamath Gap apparently is a prominent factor in the interchange of species between the western and the eastern sides of the Cascades. It is not to be inferred from this that the gap is the only avenue through which species from the west found their way east, or vice versa. There are several other gateways through the Cascades in Ts. 37 and 38 S.; nor is it at all certain that the red fir, sugar pine, and other species of the Upper Klamath Basin originally came from the west through any of these gaps.

ALTITUDINAL DISTRIBUTION OF SPECIES.

Below 6,800 feet on the western slope and 7,000 feet on the eastern slope, including the Klamath Basin, there are no sharply drawn lines separating the altitudinal range of the various species. Above those elevations the elements of the sylva are chiefly subalpine and the limits of their downward and upward extensions become more closely drawn.

The lower altitudinal limit for species on the eastern side of the Cascades is uniformly at a greater elevation than for corresponding species on the western side. This is due to the fact that isohyetal lines drawn from west to east through the Cascades will lie at a higher altitude on the eastern side than they do on the western. As the eastern slope has undoubtedly a lower mean annual temperature than the western it follows that the range of the species of coniferous trees indigenous to this region depends here more on moisture conditions than on temperature factors.

The principal limits in the altitudinal extensions of the various conifers are exhibited in the following table:

Altitudinal range of conifers in Cascade Range Reserve and adjacent region, Oregon.

WEST OF THE CASCADES.

Yellow pine	Between 1,300 and 6,000 feet, reaching its best development between 4,000 and 5,500 feet.

Sugar pine	Between 3,000 and 5,000 feet, with greatest development between 3,500 and 4,500 feet.
White pine	Between 5,000 and 7,500 feet, reaching its best development along the line of the lower elevation.
White-bark pine	Between 6,000 feet and timber line, or 9,300 feet.
Lodgepole pine	Between 3,500 and 8,000 feet, some varieties reaching their best development at 4,500 feet, others at 7,500 feet.
Red fir	Between 2,500 and 6,800 feet, attaining its best and most abundant development between 4,000 and 5,800 feet.
White fir	Between 3,000 and 6,000 feet, its best development being between 4,500 and 5,500 feet.
Noble fir	Between 5,200 and 8,800 feet, with its greatest dimensions between 5,800 and 6,800 feet.
Alpine fir	Between 5,800 and 7,800 feet.
Western hemlock	Between 5,200 and 6,000 feet.
Alpine hemlock	Between 6,200 and 9,200 feet, or very close to timber line, its best development both as to numbers and dimensions occurring between 5,900 and 7,000 feet.
Incense cedar	Between 2,500 and 5,000 feet.
Engelmann spruce	Between 5,800 and 8,000 feet.
Western juniper	Between 1,600 and 5,200 feet.

EAST OF THE CASCADES.

Yellow pine	Between 4,000 and 7,000 feet, reaching its best development between 5,000 and 6,200 feet.
Sugar pine	Between 4,800 and 6,000 feet, with its best development along the 5,200-foot contour.
White pine	Confined to the immediate declivities of the main range at elevations varying from 5,500 to 6,000 feet.
White-bark pine	On the Cascade slopes and summits between 6,000 and 9,300 feet; in the interior of the Upper Klamath Basin between 7,800 and 8,500 feet, or to the top of the highest summits in that region.
Lodgepole pine	Between 4,200 and 8,500 feet, most plentiful and of largest dimensions along the 5,200 and 5,800-foot contours.

Red fir	Between 4,300 and 7,000 feet, in the interior of the Upper Klamath Basin not below 6,000 feet.
White fir	Between 4,000 and 7,500 feet, attaining its best development near the 6,000-foot contour.
Noble fir	Between 6,000 and 8,800 feet, confined in its range to the immediate slopes of the main range of the Cascades.
Alpine fir	Between 5,880 and 7,800 feet, its range not extending beyond the declivities of the Cascades.
Alpine hemlock	Between 6,000 and 9,200 feet, confined to the Cascades.
Incense cedar	Between 5,000 and 6,600 feet.
Engelmann spruce	Between 5,600 and 8,000 feet, limited in its range to a few of the larger canyons and wetter slopes of the Cascades main range.
Western juniper	From the lowest elevations to altitudes of 6,000 feet.

In the interior of the Klamath Basin none of the elevations reach timber line. In the Cascades Mount Thielsen, Mount Scott, and Mount Pitt have a true timber line irrespective of point of exposure along their slopes. The timber line on the southern slopes, where it is highest, is between the 9,300- and the 9,400-foot contour lines.

The timber-line tree is the white-bark pine. A hundred feet or so below its upper limit the alpine hemlock comes in, soon joined by the noble fir and alpine fir, with lodgepole pine and an Engelmann spruce here and there. White pine, red fir, white fir, incense cedar, and yellow pine in descending order complete the scale of coniferous growth, which on the western side of the Cascades ends in a fringe of oak and madroña, and on the eastern side in stands of western juniper.

If the interior of the Upper Klamath Basin possessed elevations of sufficient altitude to reach the timber-line limit there is scarcely any doubt but that the white-bark pine would form the timber-line tree here as well as in the Cascades. None of the Siskiyou peaks in the region explored reach timber line, nor were any found on the Umpqua-Rogue River divide west of its junction with the Cascades.

FOREST TYPES.

The elements or species which compose the forest are grouped and assembled in many different aggregations. These groupings may be considered under two aspects, viz, general or zonal aggregations, and limited or species groupings. The former is designated here as types, the latter as subtypes.

The term forest type, as here employed, is used to define large aggregations of one or many species of trees, usually comprised within definable territorial limitations.

The term subtype is applied to a multitude of lesser groupings of the species which form the type. Collectively they give to each type its characteristic features.

The composition of the forest types of any particular region is determined by the species of trees which form its sylva. As our forested regions consist of mountainous country the types have an upward as well as a downward and lateral extension. Climatic features, as developed by varying altitudes, are the dominant factors in limiting these extensions.

The subtypes being formed from the elements which compose the types are more or less repetitions of the larger and more general types on a smaller scale. The differences which make them definable as subtypes and serve as their dividing lines consist of varying percentages or ratios of the type species.

The composition of any particular subtype depends on many different factors. Some are natural processes, such as climatic and soil conditions, altitudinal endurance of the species, or its vegetative capacities. These are the fundamental ones. Through the agency of man the relative intensity of these factors often are changed temporarily over large areas, affecting the composition of the subtypes on such tracts. Through it all, however, there runs one general cause, operative at all times and in all places. This is the factor of mean annual, seasonal, or monthly soil humidity. It can be expressed in this way: Within isothermal and isohyetal lines the composition of the forest subtypes is determined by the ratio of mean annual soil humidity of the particular tract.

The duration of the forest type is indefinite. While undoubtedly subject to evolutionary changes, its modifications or transitions to other types are so slow as to be quite imperceptible to us. Not so with subtypes. They frequently change, sometimes two or three times in a generation. Forest fires are fertile causes for inducing such rapid changes. But even when left undisturbed a subtype rarely persists in any particular locality for more than 250 or 300 years. Such at least is the rule on the eastern and immediate western slope of the Cascades and in the basins between the Cascades and the Rocky Mountains. The only exception to this rule in the region named that is known to me occurs in pure yellow-pine and western-juniper growths.

In the region described in this report there exist three general forest types, viz, the yellow pine, the red fir, and the alpine hemlock.

YELLOW-PINE TYPE.

With reference to annual precipitation and mean ratio of soil humidity the yellow-pine type occupies the lowest position of all the forest types in the region. It is the dominant type throughout the Upper Klamath Basin. On the western side of the Cascades the type is not so well developed. Here it is chiefly found in the areas situated in Klamath Gap or adjacent to it, where the dry winds from the eastern side of the Cascades have free traverse and maintain the proper degree of soil humidity. West of the Cascades its altitudinal limits lie between 2,000 and 5,500 feet; east of the range they lie between 4,500 and 6,000 feet.

It is rarely an absolutely pure type: west of the Cascades it is never so; east of the range it sometimes runs pure to the extent of 99 per cent. Generally it is more or less mixed with varying percentages of white and red fir, incense cedar, and sugar and lodgepole pine. When the forest contains yellow pine to the extent of 50 per cent, it is here considered as belonging to the yellow-pine type (Pl. LXXV, *A* and *B*).

Illustrative examples of nearly pure yellow-pine types of forest east of the Cascades are T. 31 S., Rs. 10 and 11 E., where the forest is of the following composition:

Composition of forest in T. 31 S., Rs. 10 and 11 E., Oregon.

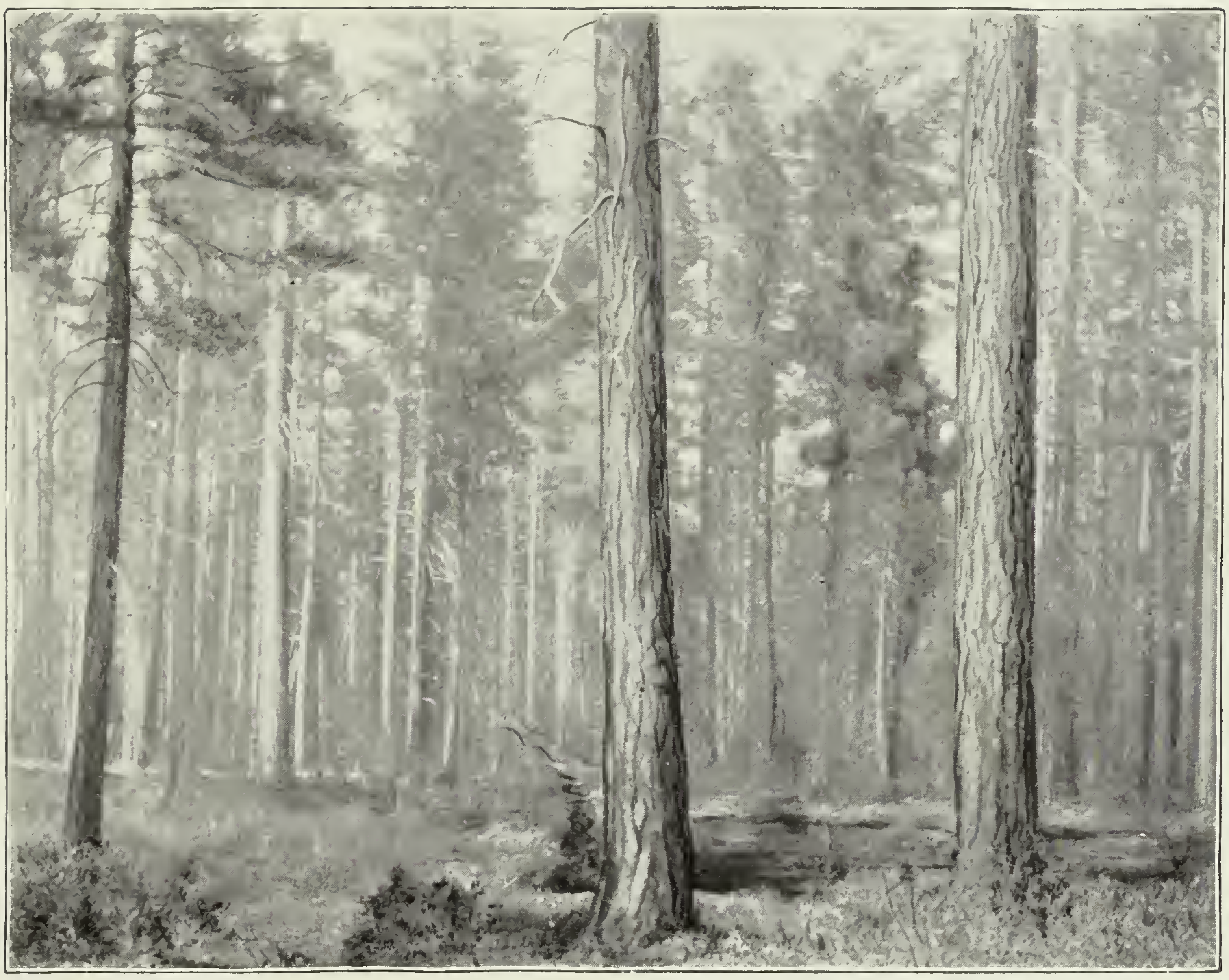
	Per cent.
Yellow pine	95
Lodgepole pine	4
White fir	1

Another example where the percentage of yellow pine is lower, but yet high enough to give the aspect of a nearly pure growth of yellow pine to the forest stands, occurs in T. 33 S., R. 10 E. The composition here is as follows:

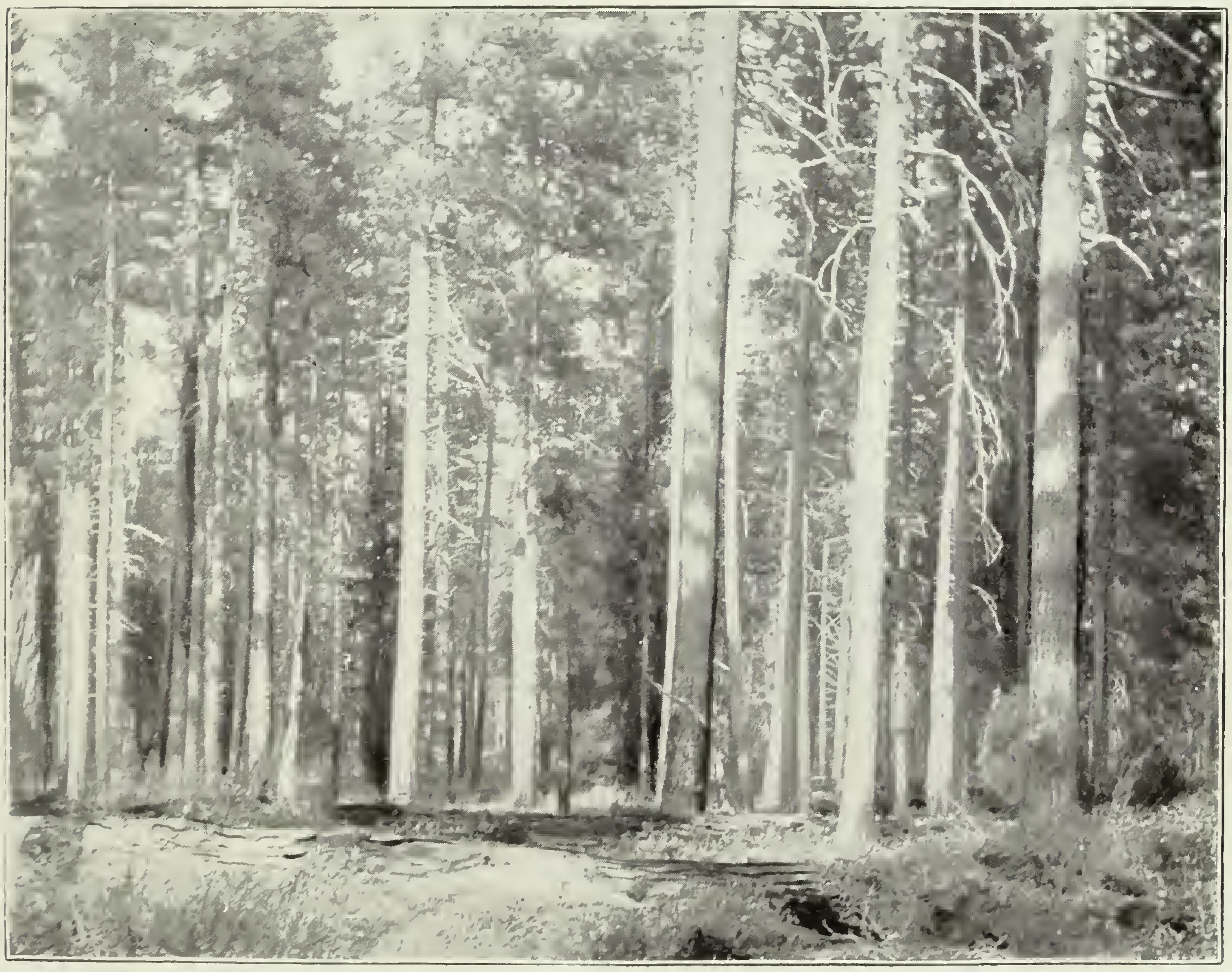
Composition of forest in T. 33 S., R. 10 E., Oregon.

	Per cent.
Yellow pine	90.
Lodgepole pine	9.5
White fir	.5

The largest admixture of other species in the examples quoted above consists of lodgepole pine. This growth here represents thin stands around marshy places or fringes along creeks and seepy spots where the soil humidity is too high for a yellow-pine growth. Near the edges of the semiarid terrace of Sprague River in T. 34 S., R. 10 E., and in T. 35 S., R. 11 E., we find the purest expressions of the type. The composition of the forest in the first-named township is: yellow pine 98 per cent, lodgepole pine 2 per cent. In township 35 it is: yellow pine 99 per cent, western juniper 1 per cent. The small percentage of lodgepole pine in the former, and the nearly



A.



B.

YELLOW-PINE TYPE OF FOREST, NEAR JOHNSON PRAIRIE, WESTERN SLOPE OF CASCADES.

entire absence of associate conifers of any species in the latter is due wholly to a low ratio of soil humidity, the soil in both of these townships being loose and porous and a poor conservator of precipitation.

The yellow-pine type west of the Cascades, as already remarked, averages a smaller percentage of yellow pine in its composition than is the case east of the range. Rarely is it as high as 70, more often it is 60, and more frequently it falls below the standard here considered as representing the type. The following examples will serve to show the status of the yellow-pine type with reference to the percentage of the species and its associates:

Composition of forest in T. 36 S., R. 1 E., Oregon.

	Per cent.
Yellow pine	70
Red fir	5
Oak	25
Madroña	

This township is situated at the lowest forested levels on the edge of the semiarid portions of Rogue River Valley. Oak and madroña being able to endure a smaller ratio of soil humidity than the yellow pine, form, as will be noticed, a large percentage of the arborescent growth. T. 40 S., R. 3 E.; T. 40 S., R. 4 E.; and T. 40 S., R. 6 E. are situated within the influence of the dry-air currents drawing through Klamath Gap. All three of the townships carry a forest of the yellow-pine type. The composition is as follows:

Composition of forest in T. 41 S., R. 3 E., Oregon.

	Per cent.
Yellow pine	60
Red fir	35
Sugar pine	5
Oak	
Incense cedar	

Composition of forest in T. 40 S., R. 4 E., Oregon.

	Per cent.
Yellow pine	60
Sugar pine	8
Red fir	30
White fir	2
Incense cedar	
Oak	

Composition of forest in T. 40 S., R. 6 E., Oregon

	Per cent.
Yellow pine	60
Sugar pine	15
Red fir	22
Incense cedar	3
White fir	

The composition of the forest in these three townships is a fair representation of the mixed character of the yellow-pine type west of the Cascades.

A comparison with the best examples of composite yellow-pine type east of the Cascades will show how completely the yellow-pine element dominates the type there. In the following two examples there are present the same component species that form the type in the two townships last quoted, with the exception of the small percentage of oak in T. 40 S., R. 4 E., which is lacking, and an addition of lodgepole pine.

Composition of forest in T. 36 S., R. 9 E., Oregon.

	Per cent.
Yellow pine	88
Sugar pine	.3
Lodgepole pine	4.7
White fir	3.5
Red fir	3
Incense cedar	.5

Composition of forest in T. 35 S., R. 9 E., Oregon.

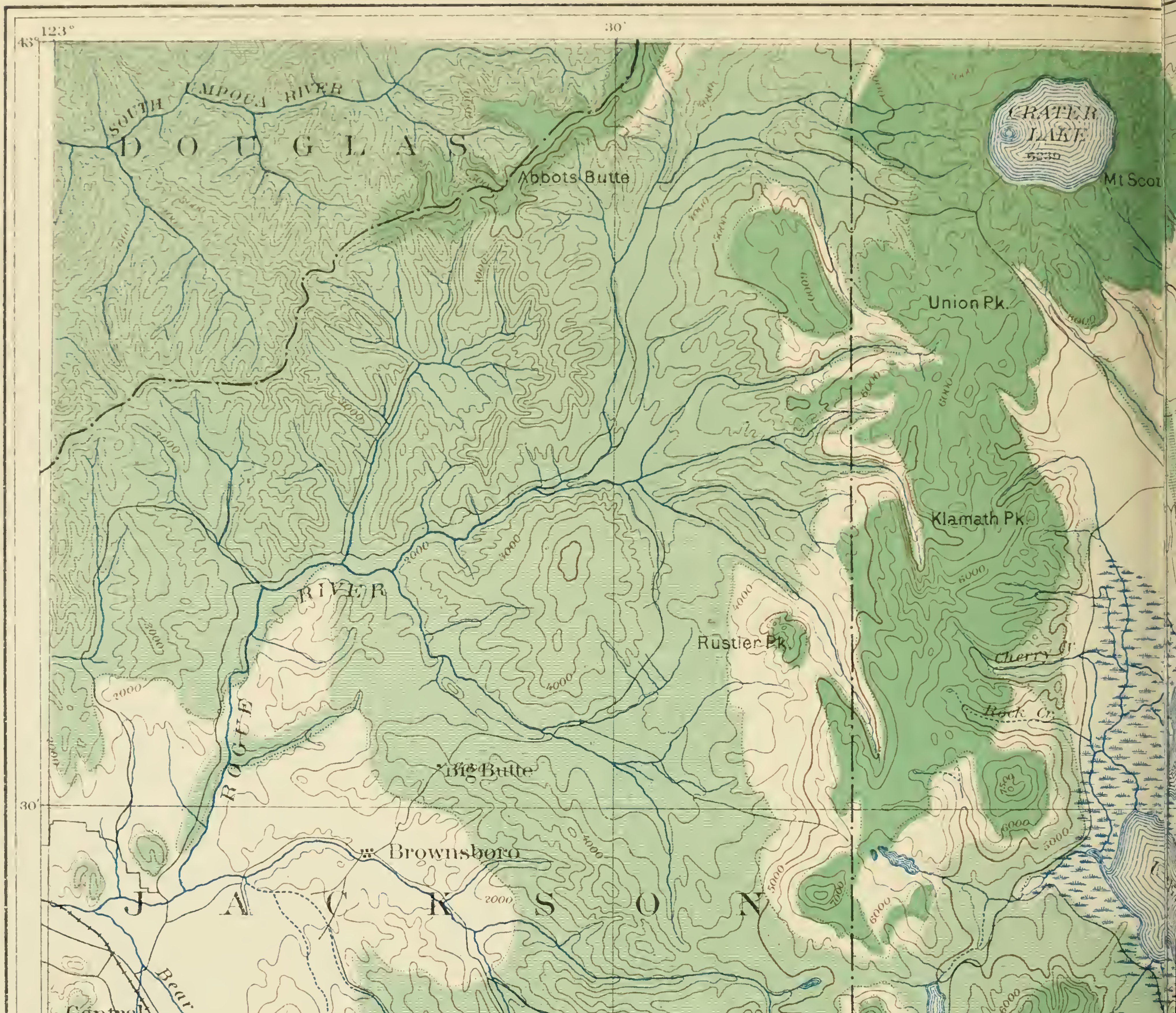
	Per cent.
Yellow pine	85
Sugar pine	.25
Lodgepole pine	12
White fir	.74
Red fir	2
Incense cedar	Trace.

If we now compare the acreage occupied by the yellow-pine type east and west of the Cascades the difference is no less striking, as may be seen from the following comparisons:

Comparison of areas occupied by yellow-pine type east and west of the Cascades.

	East of the Cascades.	West of the Cascades.
Total acreage of forested areas examined	1,592,700	1,405,740
Total acreage covered with forest of the yellow-pine type	1,450,420	330,040
Percentage of acreage bearing yellow-pine type of forest	94.2	23.5

The aspect of the type is that of an open forest with a minimum of undergrowth and seedling or sapling growth. The forest on the eastern side of the Cascades is more conspicuous in this respect than the forest on the western, owing to less variety in the frutescent flora of the former and, in general, to a smaller precipitation. But the open character of the yellow-pine type of forest anywhere in the region examined is due to frequently repeated forest fires more than to any other cause (Pl. LXXVII, *A*).



PART OF SOUTHERN OREGON SHOWING DIST

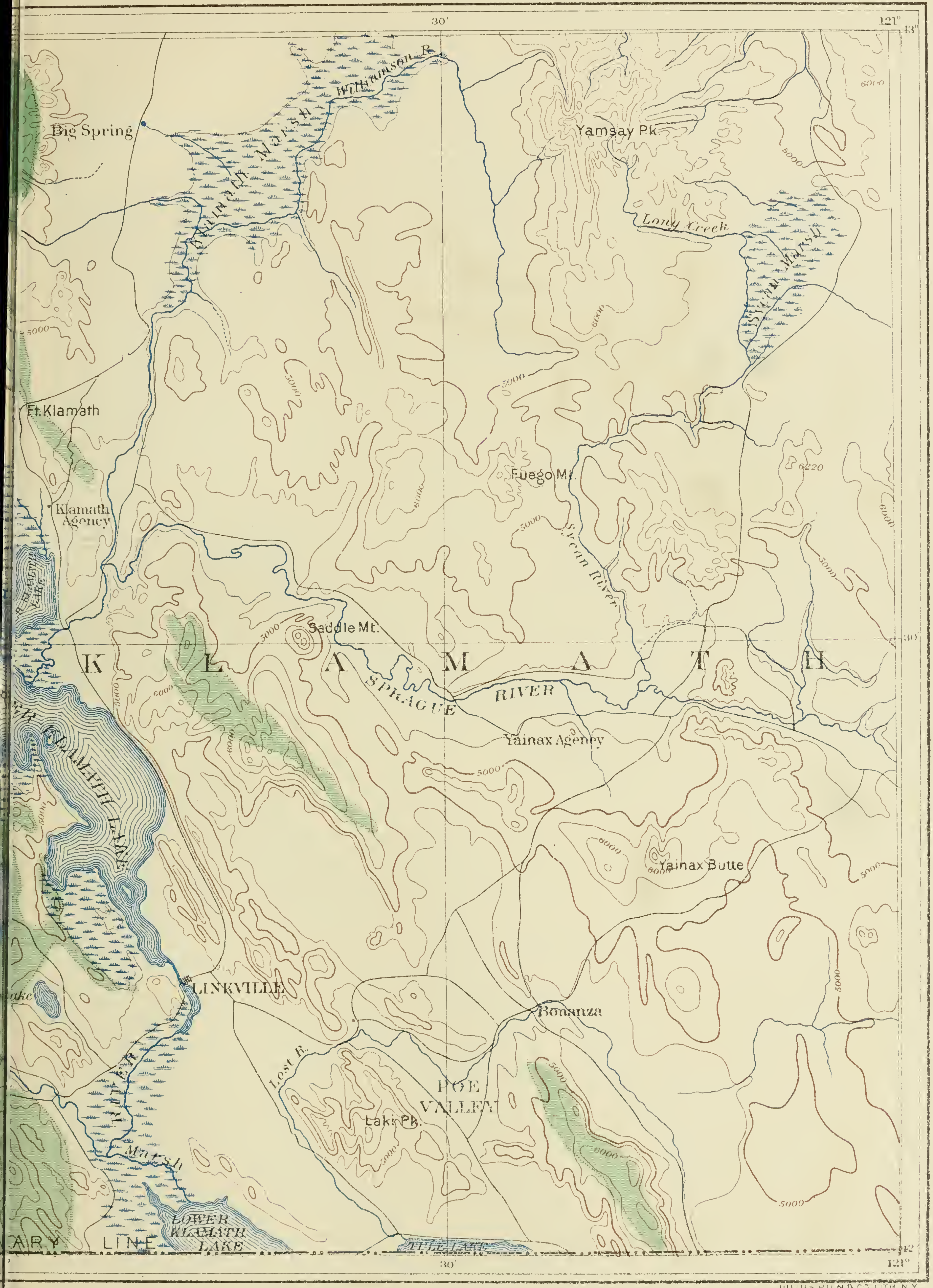
Prepared under the direction of H

BY JOHN

2 0 2 4 6 8

Contour in

🟩 Red fir



JULIUS BIEN & CO. LITH. N.Y.

RIBUTION OF RED FIR AND ALPINE HEMLOCK

ry Gannett, Geographer in charge

LEIBERG

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10 12 14 16 18 20 MILES

al 500 feet

9

🟩 Alpine hemlock

The forest floor in the type is covered with a thin layer of humus, consisting entirely of decaying pine needles, or it is entirely bare. The latter condition is very prevalent east of the Cascades, where large areas are annually overrun by fire. But even on the western side of the range, where the humus covering is most conspicuous, it is never more than a fraction of an inch in thickness, just enough to supply the requisite material for the spread of forest fires.

For lumbering purposes the type is the most valuable in the region, for the reason that it occurs in the most accessible situations and contains a maximum of the species commonly sawed, viz, yellow pine and sugar pine.

Freedom from fires insures a good and abundant reproduction of the forest type, whether east or west of the range. East of the Cascades its area is steadily increasing at the expense of tracts covered by the lodgepole pine. The process is slow, owing to fires. Were they kept down most of the lodgepole-pine areas on high ground would give way to pure or nearly pure growths of yellow pine. West of the Cascades the yellow-pine tracts in some places barely hold their own. Along their upper and higher limits there is occasionally a decided tendency toward a larger proportion of red fir as the coming forest. In the middle elevations of its range yellow pine is often found to have supplanted tracts of nearly pure red-fir stands. This shifting about is due chiefly to forest fires. On areas where yellow pine has replaced red fir there has been a decrease in the ratio of soil humidity necessary to the maintenance of the red-fir preponderance. The same condition has existed along the upper limits of the type where now red fir shows a coming ascendancy over the yellow-pine element, due to a return to higher soil-moisture ratios. Cases of yellow pine replacing red fir are common enough in the heavy red-fir growth in Ts. 30, 31, 32, and 33 S., R. 3 E., while the reverse is observable on all of the higher tracts in the yellow-pine townships situated in Klamath Gap.

YELLOW-PINE SUBTYPES.

Of the lesser and individual groupings or aggregations of the species which form the yellow-pine type, but one east of the Cascades deserves notice. The other subtypes are so thinly scattered among a preponderance of yellow pine that they are wholly lost sight of.

The subtype referred to is formed by pure or nearly pure growths of lodgepole pine. It might well be named the lodgepole-pine subtype. It occurs under two aspects. First, in the *contorta* form of the species; secondly, in the *murrayana* form. The aspect of the *contorta* form is that of dense masses of small, scraggy, limby trees forming a thick fringe along edges of marshes, creeks, or springy localities, or covering low, level areas, occurring in every case where the ratio of soil humidity is too high to permit the growth of any other coniferous species indigenous to the region. The aspect of the *murrayana* form, in its ultimate development, is that of close or moderately open stands of tall, straight, slender trees covering well-drained uplands. This form of the subtype is in every case a reforestation after fires, in this region after stands of yellow pine. Between the two forms there are many gradations.

The characteristic feature of the subtype is its habit of forming pure growths. In this respect it stands preeminent among the coniferous species which make up the sylva west of the Rocky Mountains and north of the California line. In this region these growths often cover large areas. The most conspicuous examples occur in Ts. 30 and 31 S., Rs. 7 and 8 E., where lodgepole-pine stands cover 40,000 acres out of a total of 48,000 forested, with a growth that averages 99 per cent pure.

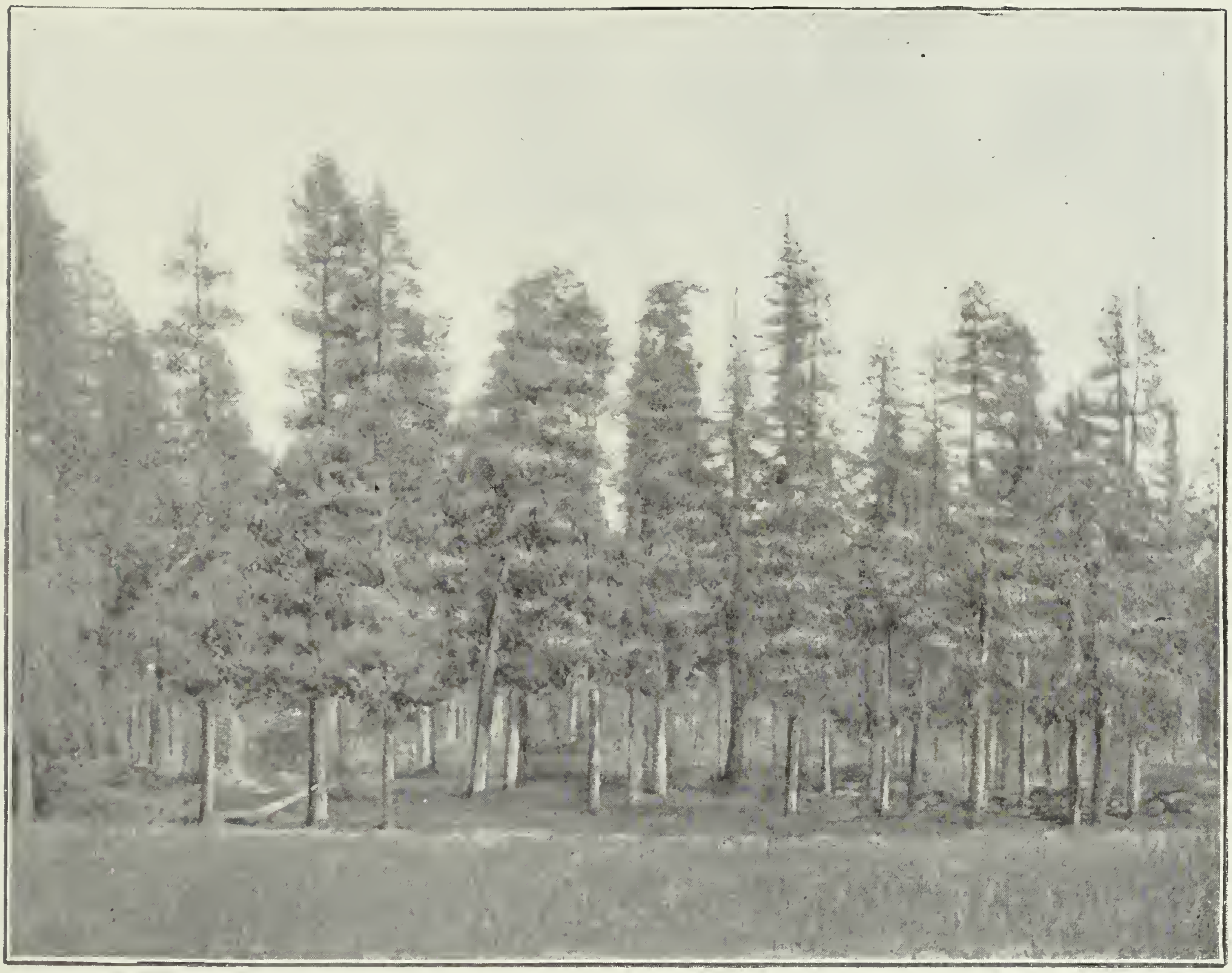
The yellow-pine subtypes west of the Cascades consist of pure growths of the *contorta* form of lodgepole pine, aggregations of red fir and white fir in varying ratios, and groups of broad-leaved species mostly oaks and madroña.

The madroña rarely forms groups by itself. Usually it is scattered throughout otherwise nearly pure stands of yellow pine, where it forms a sort of undergrowth. Pure stands of small extent are met with in T. 39 S., R. 2 W., occupying the outer edge of the yellow-pine growth where it abuts upon semiarid areas. Frequently it forms a small percentage in oak copses scattered throughout the yellow-pine tracts.

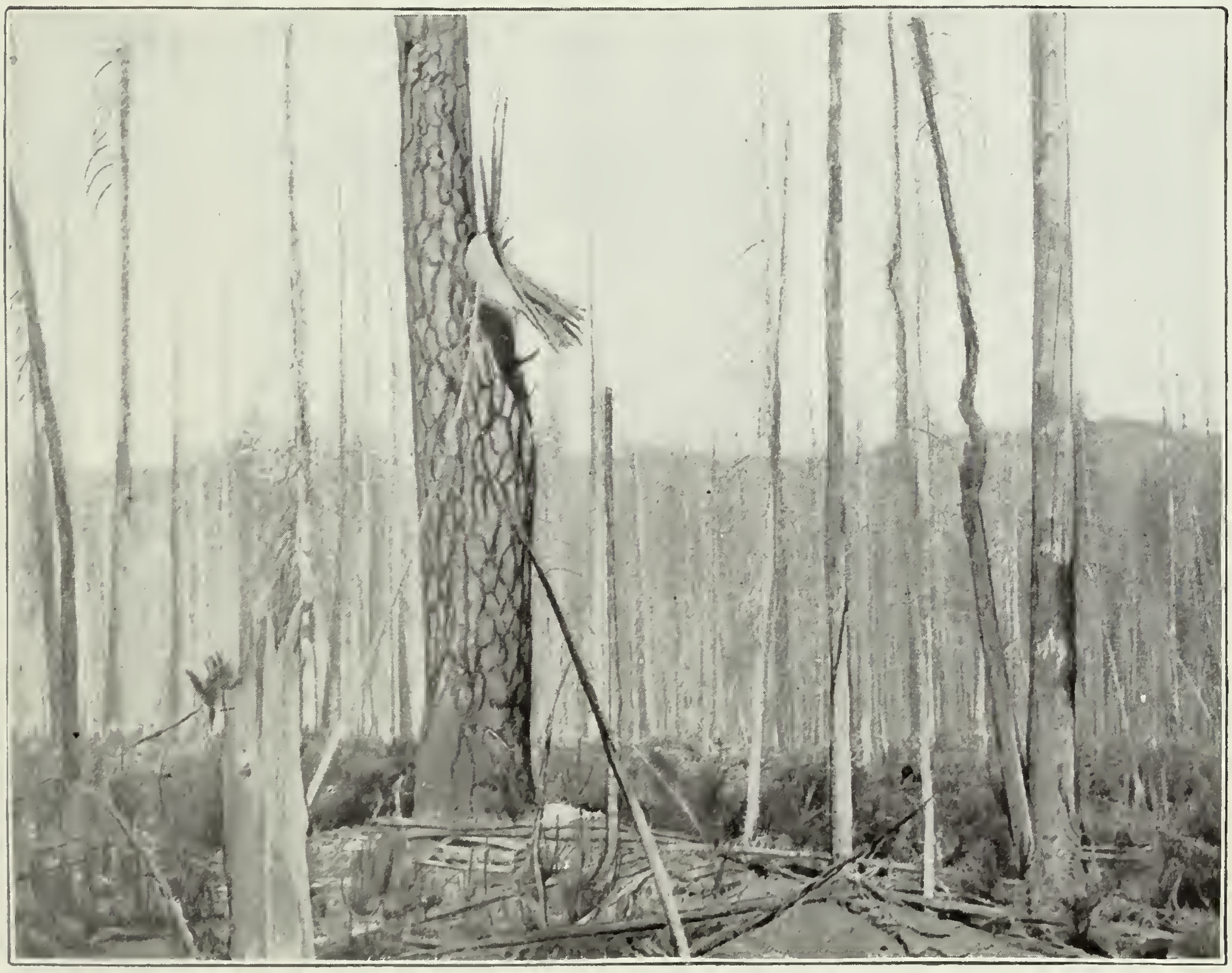
The two species of oak peculiar to the region often constitute the larger percentage of arborescent growth on the lower areas of the yellow-pine forest. They form open growths, sometimes with a great deal of underbrush composed of *Ceanothus cuneatus* and other ceanothi, service berry, hawthorn, and the like; at other times the oak stands are entirely free of undergrowth of any sort. The more open oak growths, where they form a fringe between the yellow pine and the nonforested semiarid tracts of Rogue River Valley are from 95 to 100 per cent pure growths. At higher elevations with greater ratios of precipitation and soil moisture they run from 40 to 60 per cent oak, the balance consisting of pine and fir or of madroña and other species of broad-leaved trees.

The lodgepole-pine subtype is infrequent in the strictly yellow-pine type of forest. It is lacking in the Siskiyou Mountains, so far as examined, but occurs in the Umpqua Range and along the upper limit of the yellow-pine type on the Cascades slopes. As before remarked, it is invariably of the *contorta* form, and, like its prototype east of the Cascades, it is always found as a fringe of arborescent growth along the edges of marshy or springy places.

The subtypes formed by aggregations of red and white fir are more



A. YELLOW-PINE TYPE OF FOREST, EAST SIDE OF WILLIAMSON RIVER, UPPER KLAMATH RIVER BASIN.



B. BURNT YELLOW PINE, ROGUE RIVER VALLEY, NEAR MILL CREEK.

common and characteristic than any of the others. They are scattered almost everywhere throughout the stands of the type. They are never singly of large extent, from a half acre to one acre being an average size. The ratios in which the species occur are greatly varied, but the following proportions predominate in the majority of instances:

Proportion of species composing yellow-pine subtype of forest.

	Per cent.
1.	
Red fir	60
White fir	35
Yellow pine	5
2.	
Red fir	35
White fir	45
Yellow pine	20
3.	
Red fir	50
White fir	50
4.	
Red fir	80
White fir	20

The development of subtypes with these compositions in the general yellow-pine type of forest, and their capacity to maintain their relative species ratio until maturity is due solely to the presence of the required degree of soil humidity on the particular tracts that they occupy throughout the seasonal changes of the year. The subtypes occur, as a rule, in or along hollows or depressions in the general level, on northern slopes, or on low inequalities of the ground, in short, where the required degree of soil moisture exists. Neither the presence nor absence nor relative abundance of seed trees of the species on adjacent areas has any influence upon the formation of these subtypes or aggregations. Nor do the tolerance ratios of the different elements that compose them operate in any way to change their composition between the sapling and the veteran stage.

Of the other elements which constitute the yellow-pine type the most prominent are the sugar pine and the incense cedar. They rarely form any considerable groups or aggregations together or singly, being found mostly as scattered trees among the other species. The reproductive capacities of the two species appear to be much inferior to those of the other conifers that make up the yellow-pine forest type, which partly accounts for their relative scarcity, but in addition some causes not understood undoubtedly operate in limiting the increase in volume and numbers of these species.

RED-FIR TYPE.

The red-fir type of forest occupies areas generally situated at higher elevations than those of the yellow-pine type, hence these areas have considerably greater precipitation and soil humidity. The lower limits of the type adjoin the upper boundaries of the yellow pine; the upper limits encroach upon forest conditions belonging to subalpine types.

The red-fir type is not well represented on the eastern side of the Cascades, although it is by no means wholly absent. On the western side it is the dominant type. Its altitudinal limits on this side of the range lie between the 3,800- and 6,200-foot contours. Its altitudinal range on the eastern side is between 5,500 and 6,500 feet, and it is confined to the immediate slopes of the main range of the Cascades and to those of the secondary range between Upper Klamath Lake and the Cascades.

The red-fir type is never a pure type here. In not a single place in the entire region were as much as 200 acres carrying a pure growth of red fir found in one body. While the red-fir component often overwhelmingly outnumbers all the other elements in any particular stand there always is a sufficient quantity of the other species present to make the admixture conspicuous. The small pure growths of yellow pine so frequent and noticeable in the yellow-pine type are missing from the red-fir forest.

The component elements of the red-fir type of forest are: Yellow, sugar, white, and lodgepole pine; red, white, and noble fir; western hemlock; Engelmann spruce; and Pacific yew. The ratios in which these species occur vary with altitude. Along and between the 5,300- and 5,900-foot contours the red fir predominates. Below these line are found greater quantities of the species characteristic of the yellow-pine type, while above occur species more or less closely identified with the alpine-hemlock type.

The percentage of red fir in stands of the type varies from 50 per cent, which here is considered the lowest ratio for stands representative of the type, to 75 and in some cases to 85 per cent. A characteristic stand, and one which is typical of much of the red-fir forests of the region, contains about 60 per cent of red fir, the balance being made up of varying ratios of white fir, sugar pine, yellow pine, and occasional trees of incense cedar.

As exhibiting the composition of the red-fir forest type the following examples may be cited:

Composition of forest in T. 32 S., R. 1 W., Oregon.

	Per cent.
Red fir	70
White fir	8
Yellow pine	20
Sugar pine	2
Incense cedar	

This township is situated along the summit and higher slopes of the Umpqua-Rogue River divide, in a region where the red-fir forest is generally heavy and of tolerably uniform composition. It is a reforestation after an extensive fire which burned about one hundred and twenty years ago, and the red-fir component is as yet below standard with reference to its average height and diameter.

Coming nearer to the main range of the Cascades we find a few townships covered with a massive red-fir growth of great age, and fairly representative of the best and ultimate development of the type in this region. They have suffered comparatively little from modern fires and the forest has been permitted to adjust its composition without the interference of man. The townships referred to and the compositions of their forests are as follows:

Composition of forest in T. 32 S., R. 3 E., Oregon.

	Per cent.
Yellow pine	9
Sugar pine	22
White pine	1
Lodgepole pine	1
Red fir	60
White fir	6
Western hemlock	.5

Composition of forest in T. 33 S., R. 3 E., Oregon.

	Per cent.
Yellow pine	2
Sugar pine	12
White pine	.2
Red fir	75
White fir	10
Western hemlock	.2
Incense cedar	.1

Composition of forest in T. 34 S., R. 3 E., Oregon.

	Per cent.
Yellow pine	15
Sugar pine	5
Red fir	60
White fir	18
Western hemlock	.5
Incense cedar	1

As exhibiting the composition of the red-fir type at lower elevations, or where humidity conditions approach those which determine the yellow-pine type, the following may be taken as representative:

Composition of forest in T. 35 S., R. 2 E., Oregon.

	Per cent.
Yellow pine	30
Sugar pine	1
Red fir	55
White fir	5
Incense cedar	2
Oak	7

Composition of forest in T. 40 S., R. 1 W., Oregon.

	Per cent.
Yellow pine	25
Sugar pine	5
Red fir	55
White fir	5
Incense cedar	2
Oak and madroña	8

Along the upper altitudinal limits of the type are found small percentages of trees belonging to the alpine-hemlock type. They replace, in a large degree, the yellow and sugar pine components of the middle and lower elevations. Examples of this aspect of the type occur, among others, in the following townships:

Composition of forest in T. 37 S., R. 4 E., Oregon.

	Per cent.
Yellow pine	.2
White pine	6
Lodgepole pine	.8
Red fir	64
White fir	18
Noble fir	10
Engelmann spruce	.8

Composition of forest in T. 30 S., R. 2 E., Oregon.

	Per cent.
Yellow pine	10
Sugar pine	3
White pine	2
Red fir	68
White fir	6
Noble fir	11

Examples of this kind are not common in this region. The tendency of the red-fir type here is always toward added or greater ratios of the species requiring less moisture for their growth. In other words, throughout the region examined west of the Cascades there is everywhere a clearly marked extension of the yellow-pine type elements into the areas of the red-fir type, where they are slowly but surely supplanting the species that need a high degree of soil and atmospheric humidity with species which require a smaller ratio of these factors of growth.

As already mentioned, the red-fir type is not common east of the Cascades in the Upper Klamath Basin. The only localities where it is at all well developed are the Lake of the Woods depression and some of the areas draining into Klamath Gap. The townships noted below are examples of the aspect which the type assumes here:

Composition of forest in T. 40 S., R. 7 E., Oregon.

	Per cent.
Yellow pine	40
Sugar pine	5
Red fir	55

Composition of forest in T. 39 S., R. 6 E., Oregon.

	Per cent.
Yellow pine	31
Sugar pine	7
Red fir	50
White fir	10
Incense cedar	1

If the yellow-pine type is the dominant one east of the Cascades, the red-fir type is no less so west of the range. The following statement exhibits the comparative status of the type in the two sections:

Comparison of areas of red-fir type east and west of the Cascades.

	East of the Cascades.	West of the Cascades.
Total acreage of forested areas examined	1,592,700	1,405,740
Total acreage covered with forest of the red-fir type	58,580	817,840
Percentage of acreage bearing red-fir type of forest	3	58

From the foregoing it will be seen that the red-fir type, while the dominant one west of the Cascades, is very far from assuming the proportions that the yellow-pine type does on the eastern side of the range.

In the red-fir type the forests in these regions reach their maximum density. This holds good for the mature timber as well as for the seedling and sapling growth. The type never has the open aspect which characterizes stands belonging to the yellow-pine type. Except on areas where heavy stands of mature timber effectually shade the ground there is a good undergrowth of many species of shrubs.

Humus and litter in stands of the type are moderately abundant. On ground where fires have not run for one hundred to two hundred years humus covers the forest floor to a depth which varies from 3 to 5 inches. The litter consists of broken trees and branches. It is enormously increased in quantity when a fire, even of low intensity, sweeps through the forest.

Reproduction of the red-fir type is good, but the relative ratio of the various species which compose it are subject to many changes. I should say that the red-fir species is, on the whole, assuming minor proportions in the general composition of the type, giving way chiefly to increasing percentages of yellow pine and white fir. The change is slow and gradual, but is steadily progressing, at least on areas of low elevation along the upper limits of the yellow-pine type. While it may not be possible to prove in a conclusive manner that climatic changes are responsible for the gradual restriction of the red fir, it is at least clear enough that the gradual deepening of the numerous drainage channels which intersect the red-fir areas lessens the soil moisture in the intervening blocks of ground by a more thorough and greatly accelerated outflow, and thus prepares the way for species of more subhumid tendencies than the red fir. This phenomenon is plainly visible everywhere throughout the stands of the type. Changes of this sort are too slow, however, to affect the present status of the type. We may therefore say that on areas undisturbed by forest fires the red-fir type practically holds its own, with the red-fir species as the leading component. Where fires have ravaged the stands, the red fir will come again as the primary and principal seedling growth, provided the fire was one of low or moderate intensity. Where the stands have been totally destroyed or the destruction amounts to 75 per cent and upward red fir may come as the chief growth if the local seepage is sufficient to maintain the requisite degree of soil humidity. If this is not the case, we have reforestations where the chief components are yellow pine or white fir, or sometimes lodgepole pine of the *murrayana* form.

There are cases observable in many localities along the upper limits of the yellow-pine type where stands of red fir are slowly replacing yellow pine. These are not due to extensions of red-fir areas, but are merely cases in which the red fir is again asserting its supremacy on tracts whence it was driven by forest fires long ago (Pl. LXXVIII).

RED-FIR SUBTYPES.

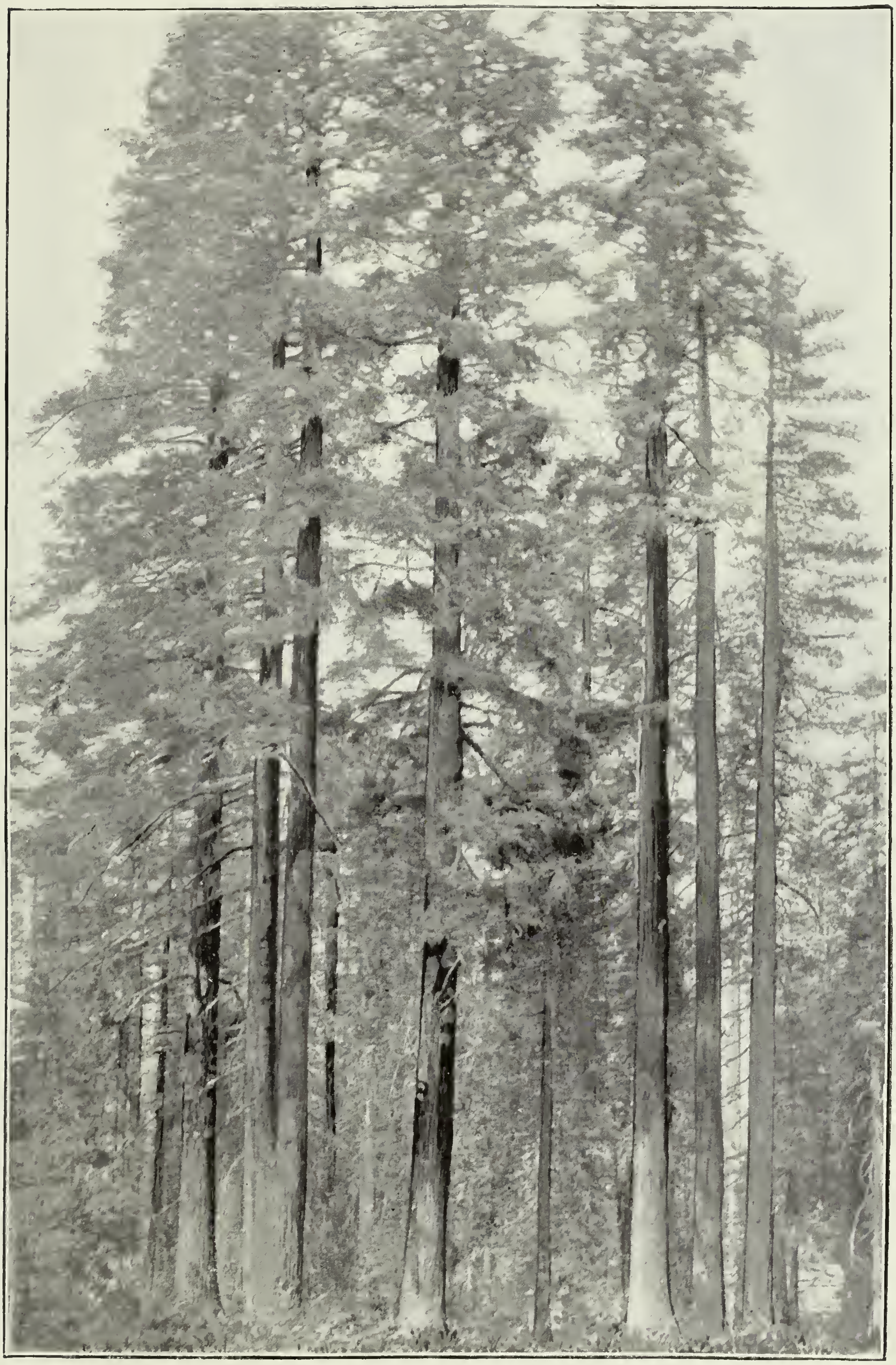
The lesser groupings of the species which form the general red-fir type are very numerous, but mostly of small areal extent in any one locality. The most common subtype in our region is one in which white fir forms the chief component. In every case the ascendancy of this species can be traced to the effect of forest fires. The most conspicuous example of the white-fir subtype occurs in T. 37 S., R. 5 E., where the composition of a forest of undoubted red-fir type is as follows:

Composition of forest in T. 37 S., R. 5 E., Oregon.

	Per cent.
Yellow pine	1
Lodgepole pine	3
Red fir	8
White fir	88

This white-fir growth is a reforestation after a fire which a hundred years ago destroyed a forest where red fir largely predominated, as is seen in the number of very aged trees of this species remaining in the later growth of white fir.

Small groupings in which the white fir forms fully as large ratios as in the locality cited above are found in many places throughout the red-fir type. It is rare, however, to find the white-fir stands maintaining their numerical superiority into maturity. It is more often the case that a white-fir stand or reforestation which starts in the seedling stage with a ratio of 70 to 80 per cent has dwindled by the time it has reached a well-advanced sapling stage to a ratio of 20 to 35 per cent of white fir, the balance being red fir principally. Were it not so two or three generations of successive forest fires would have wiped out of existence most of the red fir in this region. The stands of the white-fir subtype furnish in their numbers, extent, and ratios



GROUP OF RED FIRS, ROGUE RIVER VALLEY, NEAR MILL CREEK.

of composition unfailing guides for the estimation of the extent and age of fires in the red-fir type before the advent of the white man.

The yellow pine occasionally forms stands and becomes a subtype. We may consider it a subtype on the grounds that on the areas here in view it is a temporary reforestation after fires, and while the particular stand may grow to a sort of "immature" maturity it will not reproduce itself in a preponderating ratio. Subtypes consisting of 60 to 80 per cent yellow pine surrounded with dense red-fir growths on the same level are found in many places. Good examples occur in the massive, veteran red-fir growths in the Rogue River Valley, in Ts. 31 and 32 S., R. 3 E. Here yellow-pine reforestations have reached maturity, are in a state of decay, and are gradually being replaced by red fir, which advances from the surrounding forest to close the gap.

The sugar pine never forms stands of pure growth, nor does it ever exist among other groups in preponderating or large ratios. It is a tree that, whatever may have been the case in past times, is now decidedly deficient in reproductive capacity in this region. It therefore exists as scattered trees among the mass of red fir and other species of that type.

The lodgepole-pine subtype occurs only in the *contorta* form of the species. It is common on the slopes of the Cascades, less so on the Umpqua-Rogue River divide, while on the Siskiyou Mountains it is rare or wholly lacking in most places. Its habitat is around the edges of swamps and generally on ground too wet to permit other species of conifers to flourish, but not too wet for arborescent growth. The proportion of the species always runs high in stands of this character, seldom less than 95 per cent, the remainder consisting of poplar and cottonwood or species of willow and thorn.

The white pine rarely occurs in sufficient numbers to form stands distinguishable as subtypes. It is mostly found scattered throughout mixtures of red and white fir in the middle and upper areas of the red-fir type. Exceptions occur, however. In T. 37 S., R. 5 E., in the space between Mount Pitt and Mount Brown, is a tract of about 2,000 acres on which white pine forms 70 per cent of the forest. It is a growth 70 or 80 years old—a reforestation after forest fires. But as a rule the white pine forms a proportion varying from 2 per cent down to scattered trees in stands of composite red-fir type. It is an open question whether the species is maintaining its present general ratio in the forests of red-fir type in the region. I should say that south of the Umpqua-Rogue River divide, where the stress of advancing semi-arid and subhumid conditions is more marked than north thereof, the species is losing ground. Its reproductive capacity here is certainly poor. The number of veterans and standards throughout the forest is greater than the sapling growth of the species. North of the Umpqua-Rogue River divide the species becomes more abundant, and its upper altitudinal limits, with mill-timber dimensions, is, for some reason, considerably increased. We find it, for example, in T. 28 S., R. 5 E., at altitudes of 7,000 feet, in the subalpine forest, with diameters up to 30 inches and 150 to 175 feet in height, rivaling the best growth of the species at elevations of 5,500 feet in the central areas of the Rogue River Basin.

The noble fir is plentiful in numerous localities along the upper areas occupied by the red-fir type. Occasionally its ratio is sufficiently large to mark it as a subtype. In such cases the composition of the stands of which it forms the preponderating element are as follows: Red fir, 6 per cent; white fir, 10 per cent; noble fir, 83 per cent. An example like this is an extreme case, however, and is only found where the red fir has been burned out and the noble fir has come in as a reforestation. More frequently the percentages of the different species stand as follows: Red fir, 25 per cent; white fir, 20 per cent; noble fir, 55 per cent.

The best specimens of the noble-fir subtype in forests of red-fir type are found in T. 37 S., R. 5 E.; in Ts. 34, 35, and 36 S., R. 4 E., along the 5,400-foot contour line. There also are excellent examples of the subtype in T. 34 S., R. 6 E., east of the Cascades, on the glaciated plateau south of Cherry Creek; a habitat where the species exists under the stress of the subhumid conditions prevalent east of the range. The average ratio of the species in its relation to the entire mass of the red-fir type is, approximately, 0.001 per cent. Apparently it maintains this ratio, but there is no clear evidence of its extensions in the red-fir type beyond these figures.

The western hemlock occurs sparingly in the red-fir type, and chiefly as scattered individuals in the wetter and shadier localities in the habitats of the type. Occasionally small areas are covered with nearly pure aggregations of the species and a stand with subtype characteristics is formed. In Ts. 30 and 31 S., R. 4 E., are found such aggregations. They are limited to the trough of Union Creek, and comprise altogether but 500 or 600 acres. The percentage of western hemlock in these stands varies from 60 to 80 per cent. Similar stands occur on the banks of the North Fork of Rogue River in T. 30 S., R. 3 E., and north of the Umpqua-Rogue River divide, in Ts. 29 and 30 S., R. 2 E. The species is clearly diminishing in numbers in this region so far as its ratio as an integer in the red-fir type is in question. Nor is there any evidence of its extension into the subalpine forest type.

The Engelmann spruce is of rare occurrence as a factor in the red-fir type. Only occasional trees, scattered here and there along the upper limits of the type, are met with. This species also is one whose complete elimination from the red-fir type is here only a matter of a comparatively short period of time.

In its arborescent form the Pacific yew occurs as scattered trees only, forming an insignificant portion of the type. In its semiarborescent aspect, which is its usual mode of occurrence in this region, it sometimes is exceedingly abundant. The most remarkable example of this kind which came under my observation occurs in T. 38 S., R. 4 E., where, in a mixed growth of veteran red fir, white fir, and white pine, the Pacific yew, in a subarborescent form, constitutes an almost inpenetrable undergrowth, and, numerically, is far ahead of the strictly arborescent components of the forest stand.

ALPINE-HEMLOCK TYPE.

The subalpine areas of the region—that is, such as generally lie above 6,200 feet on the western slope of the Cascades and above 6,500 feet on the eastern—are covered with forests of the alpine-hemlock type. It thus occupies the areas having the highest ratios of precipitation and soil humidity within limits of like conditions of seepage.

While the elevation boundaries for the type given above are the general and governing ones in this region, it is not absolutely confined within those lines. On northern slopes the type sometimes dips below the 5,800-foot contour line, and it may occasionally follow the deep and shady canyons of streams even lower.

The type occurs throughout the entire length of the main range of the Cascades on both slopes, at intermittent points along the summit of the Siskiyou Mountains, and at many points on the crest and highest slopes of the Umpqua-Rogue River divide. In its southward extension to the Sierra Nevada there is a gap, about 12 or 14 miles wide, where Klamath River breaks through the Cascades, in which area the type is lacking. East of the Cascades, in the Upper Klamath Basin, the type occurs on the summit of the Yamsay Range, on the Gearhart Mountains, and doubtless at other points along the highest elevations of the Klamath-Deschutes divide.

On small areas the alpine-hemlock type is frequently pure—that is to say, composed entirely of alpine hemlock. On larger areas the type forms stands in which the same species prevails to the extent of 75 to 85 per cent. The few species of conifers which thrive at the usual altitudes of the type make the chances for stands of pure growths far more numerous and certain than is the case among the lower altitude types with their more complex composition.

The species which form the integral parts of the alpine-hemlock type of forest are: Lodgepole, white, and white-bark pine; noble and alpine fir; alpine hemlock; and Engelmann spruce. With the exception of the white and white-bark pine and Engelmann spruce, the ratio in which the species exist in the type is largely a matter of chance. Forest fires of modern date have so thoroughly destroyed the old forest that most of the growths of the type are merely reforestations of no great age. What the relative ratio of the species belonging to the type would be on any large area undisturbed by fire for a century or more, there are no means of knowing, although it is hardly to be doubted that the alpine hemlock would show a preponderating ratio.

The general ratio of alpine hemlock in the composition of the type is approximately 50 per cent as regards numbers of individuals, and 60 per cent if reference be had to the timber volume. The species which crowds it most closely as to numbers is the lodgepole pine, but it is much inferior to the hemlock in timber volume. Typical alpine-hemlock forests contain 60 to 80 per cent of the species. Such growths are especially plentiful in the region between Crater Lake and Mount Pitt. The following examples are fair specimens of the alpine-hemlock type of forest:

Composition of forest in T. 32 S., R. 5 E., Oregon.

	Per cent.
Lodgepole pine	15
Noble fir	12
Alpine fir	2
Alpine hemlock	70

Composition of forest in T. 31 S., R. 5 E., Oregon.

	Per cent.
Lodgepole pine	40
Noble fir	3
Alpine hemlock	56

Composition of forest in T. 33 S., R. 5 E. Oregon.

	Per cent.
Lodgepole pine	3
Noble fir	12
Alpine hemlock	85

These ratios are for areas comprising entire townships situated along the summit and highest slopes of the main range of the Cascades.

For comparison the central portion of T. 30 S., R. 1 E., situated on the Umpqua-Rogue River divide is cited. Its composition is as follows: Noble fir, 20 per cent; alpine hemlock, 79 per cent.

Along the lowest altitudes of its range the type is of a more composite character, as may be seen from the following example, which comprises areas situated almost wholly below 6,800 feet:

Composition of forest in T. 34 S., R. 4 E., Oregon.

	Per cent.
Lodgepole pine	11
Noble fir	21
Alpine fir	2
Alpine hemlock	50
Engelmann spruce	16

The higest limits for the alpine-hemlock type are the timber lines, varying from 8,000 feet on northern slopes of the highest peaks to 9,500 feet on southern declivities. Along the edge of extreme timber line alpine hemlock is wanting and white-bark pine reigns supreme, but 100 feet below the upper limit of this species alpine hemlock comes in and soon gains the ascendancy. The following examples, all taken from southern declivities, are illustrative:

Composition of forest at various altitudes on Mount Pitt, Oregon.

	Per cent.
Timber line:	
White-bark pine	100
300 feet below timber line:	
White-bark pine	50
Alpine hemlock	50
800 feet below timber line:	
White-bark pine	2
Alpine hemlock	88
Noble fir	10

East of the Cascades, in the Upper Klamath Basin, the alpine-hemlock type of forest is poorly developed. Almost its only constituent species is the white-bark pine, and the acreage covered by it is small.

At the present time the type is losing ground, in so far as the preponderance of the alpine-hemlock is in question. This is wholly due to forest fires which, wherever they burn in the subalpine elevations below 7,800 feet, are followed by reforestations in which the lodgepole-pine element prevails from a ratio as high as 60 per cent to total. The suppression of the hemlock through this cause is doubtless only temporary, although a century or two may elapse before it completely re-covers the lost ground.

The areas occupied by forests of the alpine-hemlock type in the region examined are of much greater extent on the western side of the Cascades than on the eastern. The following comparative statement exhibits the acreage of each of the two slopes:

Comparison of areas of alpine-hemlock type on the east and west sides of the Cascades.

	East of the Cascades.	West of the Cascades.
Total acreage of forested areas examined	1,592,700	1,405,740
Total acreage covered with forests of the alpine-hemlock type	83,700	257,860
Percentage of acreage bearing alpine-hemlock type of forest	5.5	18.3

By comparing these figures with the ratio of acreage covered with yellow-pine type of forest it will be noticed that on the western side of the Cascades the areal differences between the two types amounts to only 5.2 per cent in favor of the yellow-pine type. While these ratios apply only to the Rogue River Basin in the Cascades, and to the Upper South Umpqua Basin, I have little doubt they will be found to apply equally well to the western slope of the Cascades as far north as the McKenzie Fork of the Willamette.

The aspect and density of the alpine-hemlock type of forest vary exceedingly according to age and altitude, far more so than either the red-fir or the yellow-pine types. At high elevations a mature forest of the type consists of low, stunted individuals, set well apart. At middle altitudes the type is usually open and park-like when well advanced in age, the alpine-hemlock component being most frequently collected in groups with individuals of white pine and noble fir scattered throughout. At its lower altitudinal limits well-preserved examples of the type often present magnificent examples of forest growth but little inferior in timber volume to the best stands of the red-fir type. In such cases the type is almost wholly composed of alpine hemlock and noble fir; the trees stand 20 to 30 feet apart with long columnar trunks, and run from 100 to 200 mature trees to the acre. Stands of this kind occur on the northern slopes of the Umpqua-Rogue River divide, and in the Cascades at the head of the Middle Fork of Rogue River. They are never of any very large extent, most of them having been ruined by fire long since.

Stands of seedling, sapling, and middle-aged growth of the type are often exceedingly close set. From 4,000 to 10,000 trees to the acre in stands 20 to 40 years old are of common occurrence. Younger growths are set even closer.

The quantity of humus and litter in forests of the type depends largely upon the factor of forest fire. In old stands at middle elevations that have long enjoyed immunity from fire there is very little litter. If the situation is in the bottom of a valley there will be an accumulation of humus 3 inches to 4 inches in depth, but on the pumice-covered slopes and summits of the Cascades, even in the best-preserved stands, there is never much humus on the forest floor. In stands that have been exposed to devastation by fire the litter is usually abundant, consisting of the common débris of a partially burned forest, broken and charred trunks and limbs, dead trees still standing, and great numbers of them overthrown by wind and snow. There is no humus in such places, the deposit having been burned up in the fire.

Reproduction of the type in a broad way is good, but if examined in a special manner, with reference to its component species, the stability of the type on the ratio here adopted as its distinctive character is not promising. Neither the alpine hemlock nor the noble fir are holding their ground against the overwhelmingly great increase in the lodgepole-pine component following fires. If this species continues to extend its limits and ratios for the next forty years as it has done in the last forty or fifty years the alpine-hemlock type of forest in this region will be transformed into one consisting exclusively of pure lodgepole pine.

ALPINE-HEMLOCK SUBTYPES.

Among the aggregations or subtype groupings of the component species which form the alpine-hemlock type there are three frequent enough and covering areas sufficiently large to assume especial prominence. They are groupings in which the alpine hemlock, the lodgepole pine, and the white-bark pine each constitute 90 per cent or more of the total number of individuals in the association.

The lodgepole-pine subtype is the most conspicuous. It is composed of the *murrayana* form of the species, and invariably is a reforestation after fires. Its great development after fires indicates that, temporarily at least, the ratio of soil moisture has been reduced below the point where the growth of alpine hemlock and noble fir in any great numbers is possible. The subtype occurs in many localities on the summit and along the upper slopes of the Cascades on both sides of the range; it is especially common throughout the pumice-covered tracts, because the upper foot or two of soil made up of this material parts quickly with its moisture when exposed to the sun, and seed of other species of conifers than the lodgepole pine fail to germinate on the dry soil. In the Siskiyou Mountains the subtype is lacking, and along the Umpqua-Rogue River divide, except where it joins the Cascades, it is of small extent. In the Cascades the most conspicuous examples of the subtype occur in the region between Mount Thielsen and Union Peak. The following examples will serve to show its extent and composition in that region:

Composition of forest in T. 28 S., R. 6 E., Oregon.

	Per cent.
Lodgepole pine	95
Noble fir	3
Alpine hemlock	2

Composition of forest in T. 29 S., R. 5 E., Oregon.

	Per cent.
Lodgepole pine	92
Noble fir	2
Alpine hemlock	6

These tracts are situated on the summit and high slopes of the main backbone of the Cascades and comprise two entire townships. South of Crater Lake and extending to the northern base of Union Peak are scattered tracts aggregating thousands of acres on which lodgepole pine has replaced alpine hemlock and noble fir with stands running 99 per cent lodgepole pine.

The groups of this species in the alpine-hemlock type are destined to vanish in time, provided forest fires are absolutely kept down. At the present time they are on the increase, partly owing to recurring fires now in lodgepole stands, now in previously unburned alpine-hemlock and noble-fir growths, and partly owing to reforestations of grassed-over tracts which long ago were denuded of their forest cover by fire. At high altitudes in the Cascades a return to forest conditions of such areas is nearly always accomplished by an initial growth of lodgepole pine.

Subtype groupings of the white-bark pine are infrequent and of small extent. They occur chiefly at, or a short distance below, the timber line on a few of the highest peaks in the region. As a rule the species is thinly scattered through mixed stands of alpine hemlock and noble fir above 7,000 feet.

Subtype groupings or pure-growth stands of alpine hemlock are not infrequent along all the higher elevations of the Cascades. On the Siskiyou Mountains they are lacking, and on the Umpqua-Rogue River divide they are, collectively, of limited extent. They are especially characteristic of stands in which the species has attained middle age or maturity. The pure growths of alpine hemlock are distinguished also by another peculiarity, that of forming associations of ten to twenty-five individuals which stand so close that apparently they all spring from a common root. These small aggregations are extremely characteristic of the habit of the species at the middle and upper altitudinal limits of its growths. Numbers of these associations, more or less closely grouped together, form a shade so dense that the other component species of the alpine-hemlock type stand little chance of growth in such places. We have, therefore, pure growths of the alpine hemlock. At lower elevations, or in reforestations after fires, the alpine hemlock rarely forms these small associations, and in consequence the growth is much mixed with other species.

The cause of the small, close groupings of the species which are so noticeable and striking is not wholly clear. Apparently many individuals (I have counted as high as thirty-five) spring from a common root. At low elevations—that is, at the lower limits of the altitudinal range of the species—the phenomenon is extremely rare, but beyond a certain point in elevation the bulk of the species occurs in these close associations. My observations lead me to the conclusion that this method of growth is due primarily to some peculiarity in the dispersion of the seed of the species at high elevations which does not exist at lower levels. According to this theory each association represents the germinating seeds in one cone, torn off before seed dispersion had taken place and more or less deeply buried in the soil where it fell. The young seedlings, crowding each other closely, have become united through a process of natural graftage where the crowding and abrasion of the bark and cambium first began, namely, at the root crown or short distances above it.

On the Umpqua-Rogue River divide and on the slopes of the Cascades the noble fir does not often form groupings in which it occupies the dominant ratio, but on the crest and high southern slopes in the Siskiyou Mountains, from Siskiyou Peak as far west as my examination extended, the species covers large areas with stands in which its ratio runs from 90 to 95 per cent. In these mountains it is the dominant species in the alpine-hemlock type of forest.

White pine, alpine fir, and Engelmann spruce mostly occur as scattered individuals or small aggregations in mixed stands of alpine hemlock and noble fir. Occasionally, in the high country between Mount Pitt and Klamath Point, the spruce in some of the canyon bottoms is present in as high ratio as 75 per cent. An example of this kind exists in T. 34 S., R. 5 E., in the upper portions of the canyon of the South Fork of Rogue River. The forest is an old growth not visited by fire for perhaps three hundred years. The soil is exceptionally deep and is swampy or watersoaked. The composition of the stand is as follows:

Composition of forest in T. 34 S., R. 5 E., Oregon.

	Per cent.
Engelmann spruce	75
Lodgepole pine	20
Noble fir	4.5
White pine	.5

THE FOREST AS A COMMERCIAL FACTOR.

The forest in this region possesses a twofold value: First, as a commercial factor in its relation to the demand and supply of lumber products and fuel; second, in its more or less obvious effects upon streams. It will here be considered in its commercial aspect.

AMOUNT AND DISTRIBUTION OF COMMERCIALLY VALUABLE TIMBER.

Commercially valuable timber is, strictly speaking, any kind of timber having sufficient dimensions to make it available for use either in the manufacture of the various lumber products entering into trade or in the coarser stuffs utilized as fuel. Obviously, therefore, if we desire to know the ultimate and actual timber resources of any particular area the standard employed in their estimation must be sufficiently broad to cover all classes and dimensions of the standing timber and the unit of volume must be the cubic foot.

In the forested regions of the West the cubic foot as a unit of volume is never employed in estimating timber on root. There are various reasons for this practice. First, timber is cruised and estimated chiefly for sawmill purposes, where the unit of volume is the foot B. M., and, second, accurate estimates based on the cubic foot unit are extremely difficult in the Western forests with their tall growing trees and the ever varying ratios between the perimetrical and longitudinal dimensions of the tree cone, and would involve much time and outlay without any particular benefit to the lumberman. For these and other minor reasons our estimates of the timber capacities of the Western forests are based on the board-foot measure, a system which falls very far short of expressing the true value of the forest in these regions. The difference between estimates based on cubic measurements and on board-foot measurements in the timber volumes of the Western forests is largely a matter of speculation. All cubic estimates that have come to my notice are clearly mere guesswork. They all show the same defect, that of a gross underestimation. My observations in Idaho, Oregon, and Washington have conclusively established in my mind the fact that estimates based on the board-foot unit do not show the entire timber volume by ratios varying from 300 to 2,000 per cent. In other words, the ultimate volume of timber on any given area is from three to twenty times greater than that shown in board-measure estimates.

The standard of estimates in vogue among sawmill men and cruisers is subject to a great deal of variation depending on positions of the forested tracts with reference to transportation facilities, the local or export requirements, and the general scarcity or abundance of timber. The same holds good with reference to the species of trees which are considered fit for mill timber. Thus, where timber is abundant the lodgepole pine is regarded as unfit for lumber, while in localities where timber is scarce the species is found to serve very well. Such is also the case with the white fir and other less common species.

In the region where the following estimates were made there are many local standards or practices of estimate and cutting in vogue. It was found to be impossible to reconcile these widely differing practices, and a standard was adopted designed to show the amount of timber available under fair and judicious lumbering methods. The smallest admissible dimensions were fixed at 8 inches basal diameter at 18 inches from the ground, and 10 feet of clear trunk. But it was found that in most cases these two specifications did not exist in the same individual. For this reason most of the timber estimates in this report are based upon butt diameters of 11 inches.

The species of trees generally sawn in this region are limited to three, viz, yellow and sugar pine and red fir. In some localities the incense cedar is sawn into shingles, but its use for this purpose is not common. For fencing material yellow pine, sugar pine, red fir, and incense cedar are utilized on both sides of the Cascades, and, on the eastern side in addition to the species enumerated, lodgepole pine and western juniper. As fuel the following species are made use of:

Yellow pine, sugar pine, red fir, western juniper, oak, and madroña. West of the Cascades the various oaks and the madroña are preferred for fuel purposes. Little or none of the timber is cut for railroad cross-ties or for telegraph poles.

In the estimates are included the following species of coniferous trees: Yellow pine, sugar pine, white pine, red fir, white fir, noble fir, incense cedar, western hemlock, alpine hemlock, and Engelmann spruce. In the local cruisings made in the region the above-enumerated species are usually taken into account, with the exception of white fir and alpine hemlock, which are excluded.

The total quantity of timber, with sufficient diametrical and longitudinal dimensions to make it available for sawmill purposes, growing in the region under examination was 19,981,209,200 feet B. M. in the year 1899, estimated on the basis indicated above. It was divided among the various species as follows:

Sawmill timber in Cascade Range Reserve and adjacent regions, Oregon.

Species.	East of the Cascades.	West of the Cascades.	Total.
	Feet B. M.	*Feet B. M.*	*Feet B. M.*
Yellow pine	6, 519, 896, 600	2, 957, 623, 800	9, 477, 520, 400
Sugar pine	78, 754, 800	735, 147, 300	813, 902, 100
White pine	16, 840, 000	113, 630, 500	130, 470, 500
Red fir	310, 476, 200	6, 327, 788, 600	6, 638, 264, 800
White fir	555, 092, 400	660, 433, 600	1, 215, 526, 000
Noble fir	116, 480, 000	769, 344, 400	885, 824, 400
Incense cedar	12, 670, 000	78, 723, 600	91, 393, 600
Alpine hemlock	72, 930, 000	536, 689, 800	609, 619, 800
Western hemlock		46, 718, 200	46, 718, 200
Engelmann spruce	21, 620, 000	50, 349, 400	71, 969, 400
Total	7, 704, 760, 000	12, 276, 449, 200	19, 981, 209, 200

In the above table the summit of the Cascades is taken as a divisional line between the eastern and western sections of the region.

Taking into account the acreage of the two sections the average stand per acre is as follows:

Stand of timber east and west of the Cascades.

	East of the Cascades.	West of the Cascades.
Wooded and forested area ....acres..	1, 592, 700	1, 405, 740
Average stand of timber per acre..ft. B. M..	4, 837	8, 733

A comparison of this kind is valuable only in a general way. It does not convey a true idea of the actual density of the mill timber on small tracts on either side of the range. The reason for this lies in the greatly varying age and composition of the different forest types. For example, on the eastern side of the Cascades the yellow-pine forest is frequently cut up by extensive growths of lodgepole pine, in some places 30,000 to 40,000 acres in a body or scattered in smaller bodies through a number of townships but connected by narrow lines of the same kind of growth. These lodgepole-pine stands carry no mill timber, or small quantities only, but in a classification of the land into forested and nonforested areas they obviously belong in the forested class. The actual volume of timber per acre measured by the cubic-foot unit is often very much greater in these noncommercially valuable stands than in pure yellow-pine growths scaling 10,000 feet B. M. and upward. But whatever their volume may be their presence only serves to lower the average acreage stand of mill timber on the forested areas where they occur. Much of the region under examination is composed of high subalpine regions which naturally carry light stands of timber. Extensive fires have devastated them at various times. Reforestations of all ages and differing in composition cover them. These reforestations are forest to all intents and purposes. Their timber volumes are often considerable, but the dimensions are too low to come within mill-timber classifications. In other places fires have destroyed a certain percentage of the forest. The damage may vary from 10 to 60 per cent or higher. The destruction has not been all in one place or body. The fire has run through the forest for miles, burning a tree or a group of trees here and there. All these factors become apparent enough when any large tract of forest in this region is cruised, and they lower the average stand of mill timber, where a large area is in question, with surprising rapidity. It is only when tracts of comparatively limited size are examined that a correct idea of the actual and possible stand of mill timber in this region can be formed. The following examples of mill-timber stands in different townships will give a better view of the density of the forest in various portions of the regions than can be obtained from the figures based on a general average:

Stand of mill timber in T. 32 S., R. 1 E., Oregon.

Forested area	acres	23,040
Mill timber	feet B. M.	247,240,000
Average per acre	do	10,730

This township is situated on the southern slopes of the Umpqua-Rogue River divide, and carries a forest composed chiefly of red-fir type. Owing to the rocky and broken character of the region the stand is rather below the medium density for the red-fir type.

Stand of mill timber in T. 32 S., R. 3 E., Oregon.

Forested area	acres	17,940
Mill timber	feet B. M.	452,240,000
Average per acre	do	25,264

The township is situated in the Rogue River bottoms. Its forest is of the red-fir type and represents fairly the best class of this type of forest in Rogue River Valley.

Stand of mill timber in T. 36 S., R. 4 E., Oregon.

Forested area	acres	16,040
Mill timber	feet B. M.	248,000,000
Average per acre	do	15,461

This tract is situated in the region south of and surrounding Mount Pitt, and is typical of the red-fir type at medium density.

Stand of mill timber in T. 39 S., R. 5 E., Oregon.

Forested area	acres	21,140
Mill timber	feet B. M.	328,000,000
Average per acre	do	15,515

This township is situated in Klamath Gap, and is typical of the best and heaviest yellow-pine type of forest.

Stand of mill timber in T. 41 S., R. 3 E., Oregon.

Forested area	acres	7,000
Mill timber	feet B. M.	10,000,000
Average per acre	do	1,428

This township is situated on the southern slopes of the Siskiyou Mountains and is subject to the stress of semiarid conditions. It represents the average stands of the yellow-pine type at the lower limits of its growth in this region. Between the two examples given of the yellow-pine type there are all sorts of variations, the average acreage running 5,000, 7,000, and 9,000 feet B. M. for stands of medium density.

It is in the alpine-hemlock type of forest that the stands of timber become thin and light and make the factor which is responsible for the low general average of the forest stands west of the Cascades in this region. The following examples exhibit clearly this condition:

Stand of mill timber in T. 28 S., R. 5 E., Oregon.

Forested area	acres	23,040
Mill timber	feet B. M.	40,000,000
Average per acre	do	1,736

The tract occupies the summit and high slopes of the Cascades. Fires have run through 18,000 acres of the township, destroying 75 per cent of the timber.

Stand of mill timber in T. 31 S., R. 6 E., Oregon.

Forested area	acres	21, 440
Mill timber	feet B. M.	50, 520, 000
Average per acre	do	2, 315

This township also occupies summit and high slopes of the Cascades. It is a good example of the capacity in mill timber of the better class of the alpine-hemlock type of forest as it commonly occurs.

East of the Cascades the forest does not show as great variations in the density and amount of mill timber per acre as are met with west of the range. The following townships furnish typical examples of the different grades:

Stand of mill timber in T. 31 S., R. 10 E., Oregon.

Forested area	acres	23, 040
Mill timber	feet B. M.	220, 800, 000
Average per acre	do	9, 583

This township is covered with a forest of yellow pine running 95 per cent pure. It is typical of the heaviest forest growth in the Upper Klamath Basin so far as this examination extended.

Stand of mill timber in T. 34 S., R. 11 E., Oregon.

Forested area	acres	15, 040
Mill timber	feet B. M.	79, 000, 000
Average per acre	do	5, 252

The forest in this township is representative of a medium class of stands in the region. From this average of 5,252 feet B. M. it varies to amounts less than 1,000 feet per acre where the forest comes in contact with true semiarid conditions. The forest of alpine-hemlock type carrying timber suitable for mill purposes is, east of the Cascades, confined to the slopes of this range. It averages about 30 per cent lighter than the same type west of the range.

Excluding the areas denuded of forest through logging operations, or partly cleared for purposes of agriculture, it is patent to the most ordinary observer that the present stands of timber fit for mill use are vastly below what the region is capable of producing. There is not a single township of all those examined, either east or west of the Cascades, where this does not hold true. The greatest deficiency occurs in the red-fir type, the least in the yellow-pine type, while the alpine-hemlock type holds an intermediate position.

As illustrative of the vast difference existing in stands of mill timber on areas practically identical in soil, moisture, and topographical features, the following examples are adduced:

Difference in stands of mill timber in Cascade Range Reserve and adjoining regions under practically the same conditions.

IN THE RED-FIR TYPE.

	Feet B. M.
T. 33 S., R. 3 E	806, 880, 000
T. 32 S., R. 3 E	452, 240, 000
Difference	354, 640, 000

IN THE ALPINE-HEMLOCK TYPE.

T. 36 S., R. 5 E	139, 700, 000
T. 32 S., R. 5 E	68, 960, 000
Difference	70, 740, 000

These examples are of the better classes of stands on the western side of the Cascades. Among the townships carrying lesser amounts the relative differences are much larger. On the eastern side, with its large areas of exclusive yellow-pine type, the variations are smaller, but nevertheless great enough to become conspicuous.

The question arises, If all the forested areas carried mill timber to their ultimate capacity, what amount, as the gross total, would the region contain? To deduce a fair average for each of the three forest types it is necessary to consider the natural conditions under which the forest grows.

The region west of the Cascades in the Rogue River Basin is subject to semiarid pressure from three directions, viz, from the east through Klamath Gap, from the south over the Siskiyou Mountains, and from the west by extensions into higher elevations of the low-lying, almost wholly nonforested depression at the western base of the Cascades. In the Umpqua Basin the semiarid and subhumid conditions of stress prevalent throughout the Rogue River Basin are absent, at least so far as the region examined is in question. The yellow-pine type is the portion of the forest which comes in closest contact with these semiarid pressures. Along the lower and middle limits of the red-fir type are seen the effects of the semiarid and subhumid conditions advancing through the yellow-pine type in a diminished density of stands and smaller dimensions of the trees. There is in consequence a broad belt of red-fir type lying adjacent to the yellow pine which naturally could not produce a forest of any but a medium density. The heaviest growths of this type in our region are found in a north–south belt 6 to 12 miles wide lying just to the west of the last declivities of the upper or summit terrace of the Cascade Range.

The alpine-hemlock type of forest suffers but little as yet from the upward extensions of semiarid and subhumid conditions. Its growth along the upper limits of its altitudinal range is under more or less acute stress of low mean annual temperatures, depending on the varying slope of exposure.

On the eastern side of the Cascades in the Upper Klamath Basin most of the tracts are under semiarid pressure, advancing from the south and east, and everywhere the character of the growth of the forest shows unmistakable evidence of this fact.

Considering these factors and the extent of the areas upon which they are in operation, I would place the natural average ultimate capacity of the different forest types in mill timber at the following amounts:

Ultimate acre capacity of forest types in mill timber in Cascade Range Reserve and adjacent regions, Oregon.

Type.	East of the Cascades.	West of the Cascades.
	Feet B. M. per acre.	*Feet B. M. per acre.*
Yellow-pine type	18, 000	30, 000
Red-fir type	25, 000	60, 000
Alpine-hemlock type	12, 000	25, 000

Assuming that the average age of stands of first-class mill timber is 175 years (in reality, I think it may be somewhat higher) the above computations would mean that a forest in this region left to a natural course of growth for a period of 175 years would carry the amounts specified above.

It remains to compare the present quantity of mill timber with the possible quantity which the region could carry under ordinary natural conditions. For this purpose the area logged clean will have to be deducted from the total forested areas, as it does not enter into the estimates of the present available timber, and a suitable deduction made for the areas partly logged. Reducing this latter factor to a ratio which will express its areas in acres logged, the total acreage is as follows:

Area covered by different forest types in Cascade Range Reserve and adjacent regions, Oregon.

	West of the Cascades.	East of the Cascades.
	Acres.	*Acres.*
Yellow-pine type—Forest area examined	330, 040	1, 450, 420
Logged	66, 200	33, 700
Net	263, 840	1, 416, 720
Red-fir type—Forest area examined	817, 840	58, 580
Logged	28, 300	0
Net	789, 540	0
Alpine-hemlock type—Forest area examined	257, 860	83, 700
Logged	0	0

Applying the estimates of ultimate capacity to the nonlogged areas, the results are as follows:

Ultimate total capacity of forest types in Cascade Range Reserve and adjacent regions, Oregon.

WEST OF THE CASCADES.

		Feet B. M.
Yellow-pine type	263, 840 by 30, 000=	7, 915, 200, 000
Red-fir type	789, 540 by 60, 000=	47, 372, 400, 000
Alpine-hemlock type	257, 860 by 25, 000=	6, 446, 500, 000
Total		61, 734, 100, 000

EAST OF THE CASCADES.

Yellow-pine type	1,416,720 by 18,000=	25,500,960,000
Red-fir type	58,580 by 25,000=	1,464,500,000
Alpine-hemlock type	83,700 by 12,000=	1,004,400,000
Total		27,969,860,000
East and west section collectively		89,703,960,000

The estimates give 19,981,209,200 feet B. M. as the present available timber supply under fair logging practice. Subtracting this amount from the estimates of ultimate capacity there remains in favor of the latter the vast sum of 69,722,750,800 feet B. M., which represents the amount of mill timber the forest has fallen behind in producing capacity within the past 175 years. These estimates are conservative and do not take into account the great quantities of sapling growth which also would be present. Under practical, close, scientific management, I do not doubt the producing capacity of the forest in this region would greatly exceed the figures given above.

If we now divide the amount of mill timber representing the ultimate capacity over and beyond the present amount by the time required to produce it, viz, 175 years, the yearly increment is found to be nearly 400 million feet per year. At the lowest stumpage value this increase would mean a value at the present time of $200,000 for each year of growth over the entire region. In point of fact it would mean at least 30 per cent more, for certain species and dimensions command a higher stumpage than 50 cents per thousand, and the sapling and young growth generally would be a factor of no little value. To accomplish this result would merely have required a complete suppression of forest fires, for to this cause, and to no other, is due the impoverishment of the present forest in this region.

AGE, DIMENSIONS, AND SOUNDNESS OF TREES.

The age of the timber utilized in sawmill consumption varies from 100 to 350 years. Most of the yellow pine falls below 175 years; the higher limit is reached chiefly in the sugar pine. Most of the sugar pine in the region is of great and mature age. Comparatively little red fir is sawn. It varies in age from 100 to 500 years, and some of the very large individuals seen were doubtless even older. The noble fir and white pine of mill-timber size varies in age from 100 to 350 years, most of it falling below 180 years. The alpine hemlock of mill size runs from 80 to 250 years, 120 to 140 years representing the age of the bulk of the standard growth. The white fir, with sufficient clear trunk development to come within the limit of these estimates, varies in age from 75 to 120 years.

The most common defects in the timber consist of fire scars in the yellow pine and sugar pine, usually occurring as spots in the lower third of the trunk denuded of bark and with the wood charred or burned more or less deeply. These defects are extremely common in the yellow pine east of the Cascades, where the wood of the species is more highly resiniferous than west of the range and where, in consequence, injuries of this nature are apt to extend over a larger proportion of the trunk. This defect often diminishes the lumber contents of the trunk in scaling by 10 to 20 per cent.

Most of the very aged sugar pine and red fir have rotten cores or gum cracks in their trunks. The incense cedar, on both sides of the Cascades, rarely has a sound center. It is seldom sawn except for shingles. The alpine hemlock is usually sound, even where the individuals have attained a great age, provided fire has not swept through the stands. Where such has been the case most of the trees will be found to have dead and decaying streaks through the trunk.

The dimensions of the various species run as follows:

Dimensions of species in Cascade Range Reserve and adjacent regions, Oregon.

Species.	Base diameter.	Clear trunk.
YELLOW PINE.	*Inches.*	*Feet.*
East of Cascades	14 to 48	10 to 35
West of Cascades	14 to 50	12 to 50
SUGAR PINE.		
East of Cascades	20 to 36	15 to 30
West of Cascades	25 to 96	25 to 70
WHITE PINE.		
West of Cascades	20 to 36	40 to 100
RED FIR.		
East of Cascades	14 to 28	10 to 25
West of Cascades	14 to 84	20 to 120
WHITE FIR.		
East of Cascades	18 to 36	None to 30
West of Cascades	18 to 36	None to 30
NOBLE FIR.		
West of Cascades	16 to 72	15 to 50
INCENSE CEDAR.		
East of Cascades	12 to 18	10 to 20
West of Cascades	16 to 45	20 to 65
WESTERN HEMLOCK.		
West of Cascades	10 to 14	10 to 20
ALPINE HEMLOCK.		
West of Cascades	10 to 32	12 to 50
East of Cascades	10 to 32	12 to 50
ENGELMANN SPRUCE.		
West of Cascades	10 to 30	None to 60

LOGGING OPERATIONS.

West of the Cascades 145,460 acres have been logged; east of the Cascades 57,000 acres. These operations involve the removal of all the way from 100 per cent to culling of the sugar pine alone. The most extensive operations have been in proximity to the Rogue River Valley settlements and the placer diggings southwest of the valley in the spurs of the Siskiyou Mountains. Sawmills have been erected at many places. They were small plants, sawing a while in the adjacent forest, then pulled down and moved elsewhere. The most extensive logging operations are now carried on in T. 40 S., Rs. 4 and 5 E.

Large amounts of the logged areas have been culled over by shake makers and much of the sugar pine has been cut for such purpose, involving the waste of a vast amount of valuable timber. As a rule but 10 or 12 feet or even less of the large growth sugar pine splits straight and easy enough to furnish shake material; the balance is rejected. It is not always possible to tell by a superficial examination whether the grain of a standing tree is straight or more or less twisted. The forests in the sugar-pine areas of Ts. 34, 35, 36, and 37 S., R. 3 and a part of R. 2 E., are littered with many millions of feet of rotting sugar pine rejected by the shake maker on account of slight imperfections of grain.

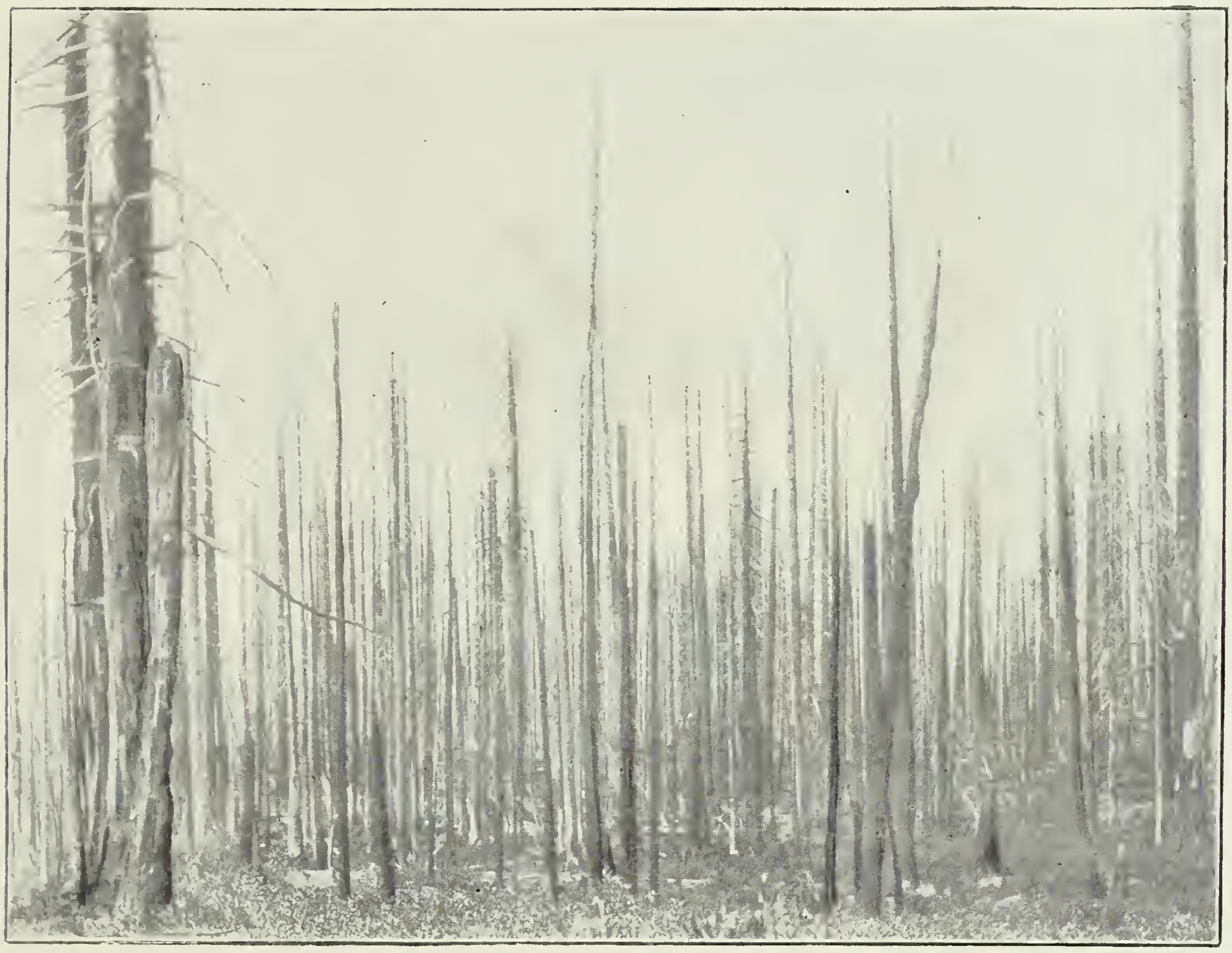
Consumption of timber for fencing material is not large. On the western side of the range firewood is mostly cut from the oak copses which grow at lower and more accessible elevations than most of the coniferous species.

Owing to the intermittent character of the smaller logging operations, it is impossible to state with any degree of certainty the yearly consumption of mill timber. The probability is that it amounts to something in the neighborhood of 100 million feet B. M. per year, including the areas east and west of the Cascades and taking into account the quantities used by shake and shingle makers. The logging operations have been confined to areas of yellow-pine and red-fir forest types. No logging or lumbering has been done in stands of the alpine-hemlock type, owing in part to the high elevations at which the type grows, which renders access to its stands difficult and expensive, and in part to the circumstance that, with the exception of the white-pine and portions of the noble-fir growth, the species which compose it are generally considered undesirable and unsaleable.

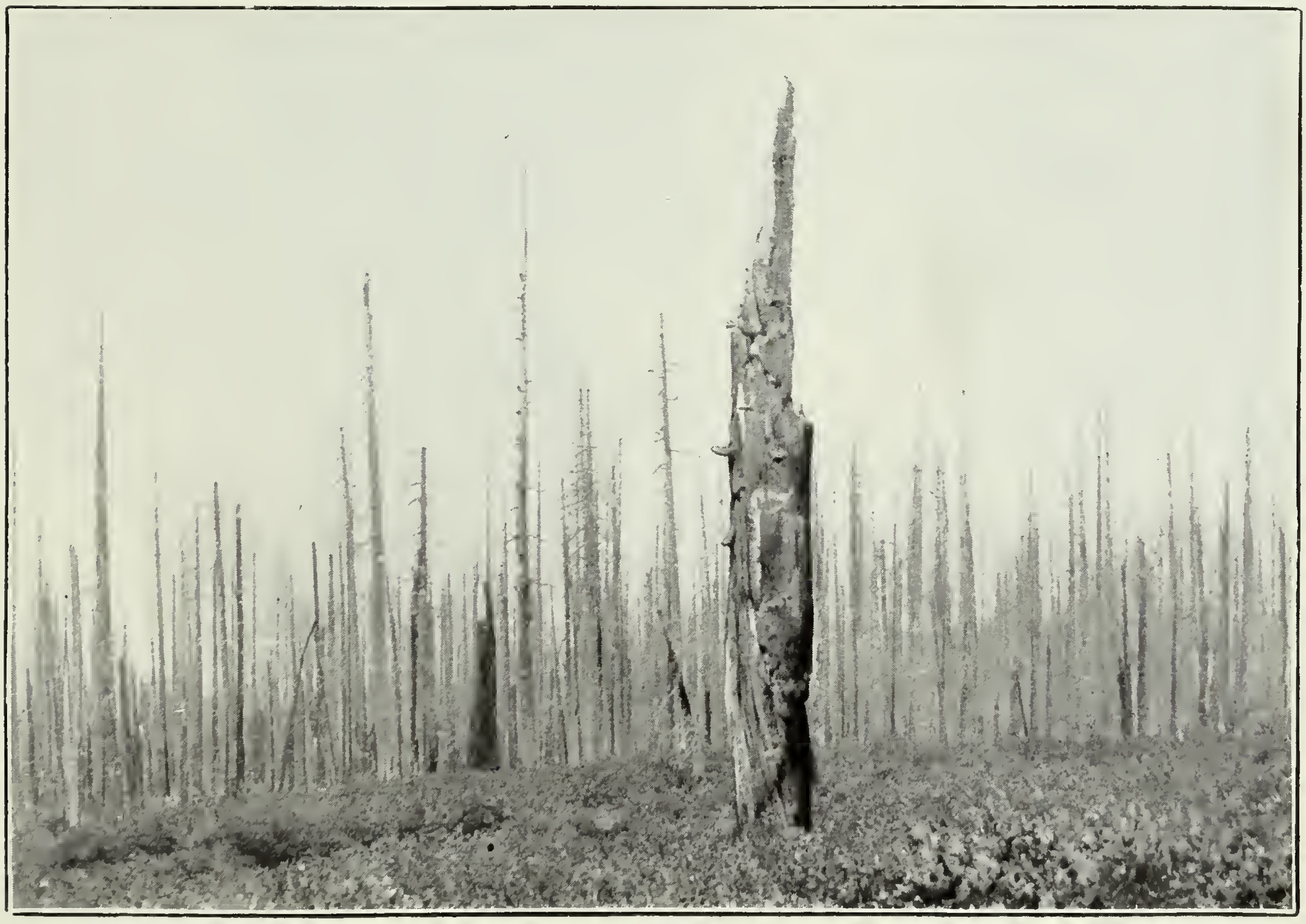
FOREST FIRES.

EXTENT OF FIRES.

Fires have widely ravaged the region examined. There is not a single forested township either on the west side or on the east side of the range in which the timber is not more or less fire marked. Without



A.



B.

BURNT ALPINE HEMLOCK, NOBLE FIR, AND LODGEPOLE PINE, NEAR HEAD OF NORTH FORK OF ROGUE RIVER.

much doubt the present agricultural areas, once grass covered and carrying scattered stands of oak, were burned over quite as extensively as the timbered tracts; at least there are few oaks that do not show fire marks. The only tracts that have escaped are the swampy sedge- and tule-covered areas bordering the Klamath lakes and marsh, and such spots at the higher elevations where bare lava or pumice fields made the spread of fires impossible.

Of the forested area examined, comprising in round numbers 3,000,000 acres, a total of 2,975,000 acres, or 99.992 per cent, are fire marked. The remaining 25,000 acres which have escaped are divided mostly in small tracts between the swampy bottoms of the Upper Rogue River forks and isolated tracts along the higher summits of the Cascades main range (Pls. LXXVII, *B*, and LXXIX).

TIME OF FIRES.

The aspect of the forest, its composition, the absence of any large tracts of solid old growth of the species less capable of resisting fire, and the occurrence of veteran trees of red fir, noble fir, white pine, alpine hemlock, etc., singly or in small groups scattered through stands of very different species, indicate without any doubt the prevalence of widespread fires throughout this region long before the coming of the white man. But, on the other hand, the great diversity in the age of such stands as show clearly their origin as reforestations after fires, proves that the fires during the Indian occupancy were not of such frequent occurrence nor of such magnitude as they have been since the advent of the white man.

The fires were more numerous and devastated much larger areas in the early days of the settlements than they have done in later years. Much the larger percentage of what may be classed as modern burns date back twenty-five to forty years. As time has passed, the frequency of forest fires in the region has much diminished. This is owing to a variety of causes, chief of which are the numerous fire breaks caused by the earlier burns; the gradual extinction of the game and consequent diminished number of hunting parties and lessened risk from unextinguished camp fires; the acquisition of valuable timber claims by private parties throughout the heavily forested sections and the measure of protection, prompted by self-interest, bestowed on their property and incidentally on adjoining areas, and, lastly, the destruction of the humus layer, the chief factor in the spread of forest fires in this region, by the earlier conflagrations and the insufficient accumulations of this material since then to support hot, large, and destructive fires.

While, as already remarked, the number of fires has much diminished in recent years, they have not by any means entirely ceased. Every year certain areas are burned over. None of the regional divisions are exempt. The eastern slope of the Cascades, the summit and middle elevations of the range, the western slope, the slopes and summits of the Siskiyous with the country intervening between this range and the Cascades, all suffer more or less from this needless infliction. And there is little prospect that it will be otherwise for many years to come.

The age of the burns chargeable to the era of Indian occupancy can not in most cases be traced back more than one hundred and fifty years. Between that time and the time of the white man's ascendency, or, between the years 1750 and 1855, small and circumscribed fires evidently were of frequent occurrence. There were some large ones. Thus, in T. 37 S., R. 5 E., occurs a growth of white fir nearly 75 per cent pure covering between 4,000 and 5,000 acres. It is an even-aged stand 100 years old and is clearly a reforestation after a fire which destroyed an old growth of red fir one hundred and five or one hundred and ten years ago. A similar tract occurs in T. 36 S., R. 5 E., only that here the reforestation is white pine instead of white fir.

The largest burns directly chargeable to the Indian occupancy are in Ts. 30 and 31 S., Rs. 8 and 9 E. In addition to being the largest, they are likewise the most ancient. The burns cover upward of 60,000 acres, all but 1,000 or 1,100 acres being in a solid block. This tract appears to have been systematically burned by the Indians during the past three centuries. Remains of three forests are distinctly traceable in the charred fragments of timber which here and there litter the ground. Two of these were composed of lodgepole pine. The most ancient one appears to have consisted of yellow pine, which would be the ultimate forest growth on this area following a long period of freedom from fire.

Along the summits of the Cascades from Crater Lake to Mount Pitt are very many even-aged stands of alpine hemlock 200 to 300 years old. These even-aged stands may represent reforestations after ancient fires dating back two hundred and fifty to four hundred years, but there is no certainty on this point.

ORIGIN OF FIRES.

It is not possible to state with any degree of certainty the Indian's reasons for firing the forest. Their object in burning the forest at high elevations on the Cascades may have been to provide a growth of grass near their favorite camping places, or to promote the growth of huckleberry brush and blackberry brambles, which often, after fires, cover the ground with a luxuriant and, to the Indian, very valuable and desirable growth. The chief purpose of the fires at middle elevations and on the plains or levels probably was to keep down the underbrush in the forest and facilitate hunting.

The white man's reasons for firing the forest in this region are much clearer. The earliest settlers found that burned-over tracts in the timber attracted game; hence the forest was fired. Many of the conflagrations spread from camp fires, which the settlers rarely took the trouble to extinguish when breaking camp. They also set many fires for the purpose of destroying the underbrush to facilitate traveling through the forest. Where roads or trails were constructed fires were set to help clear the way. The builders of a road up the North Fork of the Rogue River and across the Cascades to the Deschutes River, known as the John Day road, are responsible for large tracts burned on either side of the road.

With the advent of the stockman came the burning of the forest for the purpose of promoting grass growth. This practice still survives, and outside the patrolled areas of the Cascade Range Forest Reserve tracts of forested lands are burned every year with this object in view.

As a rule grass growths after forest fires come only along the highest slopes and plateaus of the Cascades. Fires in the middle and lower elevations usually stimulate brush growths. Some of these brush growths, consisting of hazel, mountain mahogany, scrub oak, june or service berry, and various species of ceanothi are relished by cattle, and for the purpose of providing the stock with this sort of browse the timber is frequently burned. In certain of the forested districts a new industry is springing up, that of raising Angora goats. These animals are essentially browsers and eat almost any sort of brush. A number of places were noticed along the Rogue River where the timber had been burned apparently with the sole object of providing goat browse.

Fires are often set to attract game. The larger varieties of game are now becoming scarce in the region south of the Umpqua watershed. During the fall and late summer fires are started to attract game to the smoke and save the trouble of hunting it very far from home. Deer, for example, are readily attracted to the proximity of fire and smoke. They stand in the smoke to escape the attack of flies and gnats, which are very troublesome at certain seasons of the year. Several fires started for the purpose of luring deer were observed during the summer. One in T. 33 S., R. 3 E., burned for a month in a very heavy stand of mixed red fir and sugar pine, destroying 15 or 20 million feet B. M. of merchantable mill timber before the fall rains put it out. It is not probable that more than a half dozen deer were obtained in return for this waste of timber. For similar reasons—to drive away flies and gnats—fires are often started where the forest is used for purposes of cattle and horse range. These fires are rarely tended, and they frequently spread over considerable tracts. Cases of this sort were observed in Ts. 36 and 37 S., Rs. 6 and 7 E. In the former township, at one place near Pelican Bay, a half dozen huge fires had been built in a row in the midst of a pile of inflammable forest litter. At the time of passing it had spread into the adjoining forest and had burned over between 300 and 400 acres. The fire in township 37 had started from a similar origin. When observed there was a solid line of fire for a distance of 2 miles into the adjacent forest.

Fires are not infrequently set to burn away windfalls across a traveled road. This is done to avoid the severe labor of fifteen minutes' work with the ax. By this method it often costs the public $10,000 or $15,000 to remove a rotten old log which could easily be thrown out of the road by bestowing the work of a quarter of an hour on it. A case of this kind came under my observation in T. 40 S., R. 4 E. In an attempt to remove a windfall from across a little-used road the fire in the log had spread into the adjoining forest, and at the time when I saw it had burned over about 3,000 acres.

AFTER-EFFECTS OF FIRES.

The after-effects of forest fires in this region are of two general classes. First, there are those which are due to a freer action of various atmospheric agencies on the denuded forest floor. These may be exhibited either in the form of a very decided desiccation of previously humid or subhumid areas, as regards the quantity of moisture retained in the upper layers of the soil throughout the growing season, or they may take the form of a rapid transfer of soil and rock débris from higher to lower levels. In the latter of these cases an accelerated and unimpeded drainage is the chief factor.

The second class of the general after-effects of fires consists in changes in the forest growth. These changes are of all degrees and are often exceedingly complicated. They depend upon the more or less complete destruction of the previously existing forest and very largely upon changes in the average annual soil humidity of the forest floor. The average annual soil humidity is, along isothermal and isohyetal lines, the most important factor in determining the composition of the forest in any particular district. It is subject to almost infinite variations, which as often depend on the chemical and mechanical composition of the soil as on the annual precipitation. Any interference with the annual ratio of soil humidity beyond certain points gives rise to variations in the composition of the forest on tracts where the interference has taken place. It is precisely what happens in the ditching and draining of a piece of low ground, for example, where, as the desiccation progresses, new plants tolerant of drier soil conditions come in and supplant the lowland or marsh forms of vegetation which formerly flourished there.

Widespread and intense forest fires powerfully affect the annual ratio of soil humidity on the areas burned over. To this fact is due the often strange and otherwise inexplicable changes in vegetation which occur on such tracts. The supplanting of humid forest types with subhumid ones or the change of forest to brush growth is therefore not always to be sought in climatic changes, but is often due to local disturbances in the soil moisture ratio. Such changes may be either evanescent or permanent. When permanent they are probably due to climatic changes involving aridic tendencies. We may in such cases suppose that the balance between forest and brush or between brush and herbaceous vegetation had reached an equilibrium where the slightest push toward arid or semiarid or subhumid types of growth was sufficient to tilt the balance beyond recovery to those conditions. In the region under consideration, as well as in many other places on the Pacific slope, it is evident that forest fires have supplied the requisite push.

On certain of the areas discussed in this report a special effect of forest fires is noticeable. It consists in the total destruction of every particle of soil composing the forest floor down to the hard, undecomposed lava rock. Examples of this occur in the region just south of Mount Pitt, where much of the bed rock consists of lava flows of no great age. The soil which covers these recent lava streams often is wholly composed of decayed vegetable débris with no admixture of decomposed or comminuted rock. When fire sweeps over a tract of this kind there is nothing left behind but the bare lava rock; the soil, which has required centuries for its formation and accumulation, is burned away completely. Cases of this kind are found in many places along the summit of the main range of the Cascades. They are especially numerous and conspicuous in the region between Mount Pitt and Mount Brown, the latter an extinct volcanic cone a few miles south of Pitt; on the southern slopes of Union Peak; on the lava ridges at the head of Cherry Creek in T. 34 S., R. 5 E.; and on the lava plateau to the west of Lost Peak in T. 35 S., R. 5 E. Many of the lava flows on these areas have always been bare and devoid of vegetation since they were ejected from the now extinct craters which dot the region, but by far the greater number were covered with a layer of humus soil when the white man came into the country. Stripped of soil, brush, and forest cover they present an extremely rough and desolate aspect, and many centuries must necessarily pass before sufficient soil can accumulate again to support a brush or tree growth.

The effects of forest fires in their relation to the accelerated transfer of soil and rock débris from higher to lower levels are noticeable everywhere throughout the region, but are not very conspicuous outside the pumice-covered areas. Owing to the extremely light, loose, and porous nature of this material, but little force is required to move great quantities long distances in a brief period of time. At the sources of the North Fork of Rogue River, in the main range of the Cascades, where the pumice débris is many hundreds of feet in thickness and where the forest has been burned away to the extent of 60 to

70 per cent, the increase in the ratio of surface degradation due to forest fires is conspicuous enough to arrest the attention of any observer. The numerous small affluents which form the main fork of the river lie here, for portions of their length, in deep canyons wholly excavated in the loose, fine pumice. The timber and brush which formerly grew on the canyon slopes and protected them against too rapid wastage are burned away. As a consequence, great masses of pumice are constantly sliding into the streams, the current in the river is at all times, except in winter, loaded with vast quantities of pumice, and the terminations of the canyons are rapidly extending eastward into the broad pumice plateau which forms the crest of the main range of the Cascades between Union Peak and Diamond Lake. The transportation to the lowlands and the deposition there of the fine pumice is not especially detrimental to any interest, but the destruction and removal from the upper slopes of the Cascades of the enormous water sponge of absorbent pumice sand, hundreds of feet in thickness, and the exposure of the underlying hard and often impervious lava can not fail to exert a deleterious influence upon the regimen of the streams heading in the region.

A remarkable and striking example of surface denudation in a level region, due to the destruction of the protective covering of brush and timber, and extending over a long period of time, occurs in T. 33 S., R. 13 E. The country here is a level or gently rolling region bordering Sycan River, and originally was evidently covered with a deep, uniform deposit of fine pumice, resting on rough, hard, impervious lava. The aspect of the region at the present time is that of narrow belts of timber stretching across areas of rough, barren, or thinly grassed lava fields. The belts of forest represent tracts that have escaped destruction by fire, and where, in consequence, the pumice, which is the chief soil component of the region, still remains. The rocky and barren areas are due to the burning of the forest and the subsequent exposure to unimpeded action of the various natural denuding agencies. At the present time fires occasionally run and destroy sections of the timber belts in this locality. Where such destruction takes place, there is a comparatively rapid wastage of the pumice, with the unavoidable change to a hard, sterile surface of rough lava. The rock which here underlies the pumice is a poor retainer or absorber of water. The water from the melting snow in spring and what falls as rain at other times throughout the year runs off with extreme rapidity, and but for the surrounding mountains the region would be a desert during a larger portion of the year, so far as regards the water supply.

There is little doubt that a very large proportion of the many rocky, level tracts which occur east of the Cascades in the region under consideration are wholly due, as to the character of their present surface, to frequently repeated fires. The pumice originally laid down at the bottoms of shallow lakes would be evenly spread out. As the lakes were being gradually drained thick masses of marsh vegetation would preserve the pumice surface from wastage. The marsh vegetation was finally supplanted by forest; then man came on the scene and with fire as an ally made some profound changes. The entire series of phenomena here detailed, not omitting the part played by fire, are in full operation at the present time in the region bordering Klamath Marsh, and in various other localities, such as Sycan Marsh and tracts bordering the Klamath lakes.

The pumice-covered region which is situated on the summits, slopes, and in the canyons of the Cascades, together with the level tracts east of the range, which likewise bear a surface deposit of the same material, comprise in the aggregate a very large area. Here the pumice not alone fulfills the office of soil; it is, besides, a huge water sponge, possessing enormous absorptive powers. Much of it exists in a finely comminuted state, and unless held in place by spreading roots of strong growing vegetation, or protected by a dense, tough turf, its denudation down to the underlying bed rock by rains and the water from melting snows is certain. On steep slopes the action is rapid; on level plains it is slow, but no less sure. Its action as an absorbent and retainer of precipitation is, perhaps, of little importance in the plains region east of the Cascades, so far as it relates to the regimen of the few streams that head in those tracts, but it is of great importance to the flow of the streams which head on the slopes and on the summit of the Cascades, in the region where this deposit attains its greatest thickness. Any agency, such as forest fires, much grazing, or trampling of stock, that destroys the stability of the pumice slope or level, accelerates in a high degree the ratio of pumice denudation. Evidence proving this to be true exists everywhere at the head of the streams in the pumice belt along the tracks of the great fires, and throughout the more extensively pastured sheep ranges and runs. The remedy must be sought in protecting the forest cover from fire and in regulations to restrict the unlimited pasturing of stock on the pumice-covered areas.

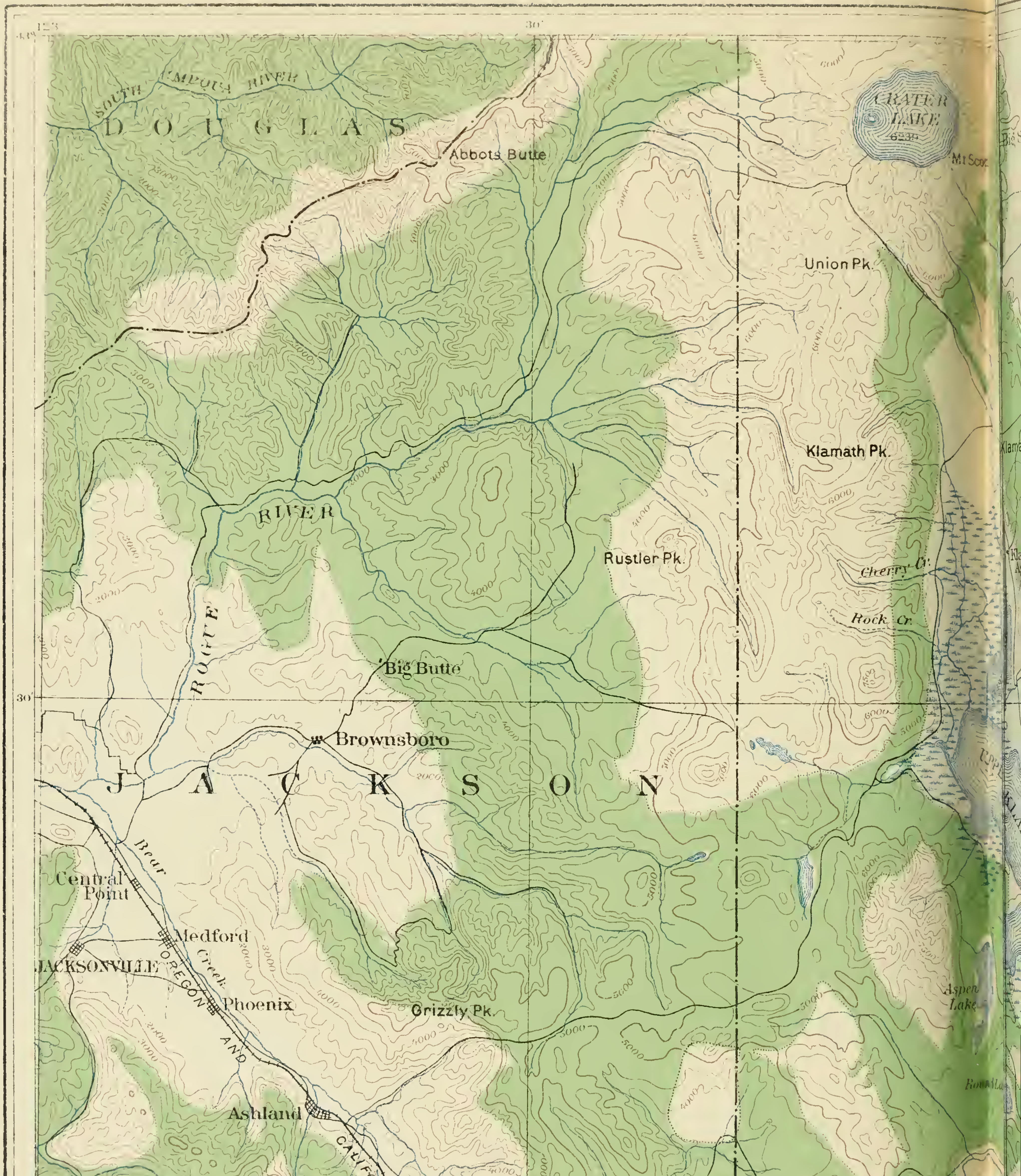
The second class of the general after-effects which follow forest fires consist in the more or less complete permanent or temporary changes which take place in the composition of the forest. There are a number of conditions created by the fires which combine to cause such changes, but my observations confirm my belief that to changes in the ratio of soil humidity must be ascribed most of the variations observed in reforestations after fires. As a rule, destruction of the forest upon any area by fire, no matter what the direction of exposure may be, tends to the production of drier soil conditions (1) by inducing increased evaporation and (2) by accelerating the surface drainage.

The result is that species of trees, or in fact any kind of vegetation which can exist on the diminished ratio of soil humidity, will, on such tracts, prevail in numbers and volume over forms of vegetation requiring more soil moisture for their growth.

In the region under consideration the proposition outlined above holds good in every case where any considerable area has been completely or nearly denuded by fire. Thus, on the summit and on the higher slopes of the Cascades from Diamond Lake southward to the north end of Lake of the Woods are very large reforestations of lodgepole pine, 80 to 95 per cent pure. The lodgepole pine has replaced a former forest of alpine hemlock and noble fir destroyed by fire. But although a great many seed trees of these species escaped destruction they have failed to reproduce themselves on the burned-over areas for no other reason than failure of their seeds to germinate on the dried-out forest floor. On adjacent areas in these same districts, where the natural seepage or soil moisture was not seriously interfered with, there are abundant reforestations of alpine hemlock and noble fir. Reforestations of lodgepole pine are of a transient character at high elevations in the southern Cascades. After a longer or shorter period of time the soil in stands of lodgepole pine regains its former ratio of moisture. This is proved by the occurrence of reforestations of lodgepole pine, which are giving way to species requiring a higher ratio of soil humidity. The more common species which replace lodgepole pine stands at the higher elevations are alpine hemlock and noble fir; at lower levels white and red fir, while in the upper canyons of the South Fork of Rogue River, Engelmann spruce is sometimes found replacing old, mature, and decaying growths. On the levels as well as on the mountain areas east of the Cascades, where the normal forest growth is chiefly yellow pine with small admixtures of sugar pine and white fir, reforestations after fires are nearly always pure growths of lodgepole pine. But in the yellow-pine areas of Ts. 41, 40, and 39 S., Rs. 4 to 6 E., inclusive, reforestations after fires are not composed of lodgepole pine. Reforestations here are yellow pine, red and white fir, sugar pine, and incense cedar; in short, the same species again come in which flourished before the fire. The reason for the difference between the two localities lies chiefly in the fact that east of the Cascades the soil is largely pumice or has considerable pumice in its composition, a soil which, when freely exposed to the direct rays of the sun, rapidly parts with its moisture to a depth of 2 or 3 feet, while the soil in the townships enumerated is of a different quality and is tenaciously retentive of moisture.

Reforestations after fires at middle elevations on the western slopes of the Cascades and in the more humid sections on the eastern slope, between 5,000 and 6,000 feet, are extremely varied and complex. But, although we can not express the determining factor of these

U. S. GEOLOGICAL SURVEY



PART OF SOUTHERN OREGON SHOW

Prepared under the direction of Hen

BY JOHN B L

Scale

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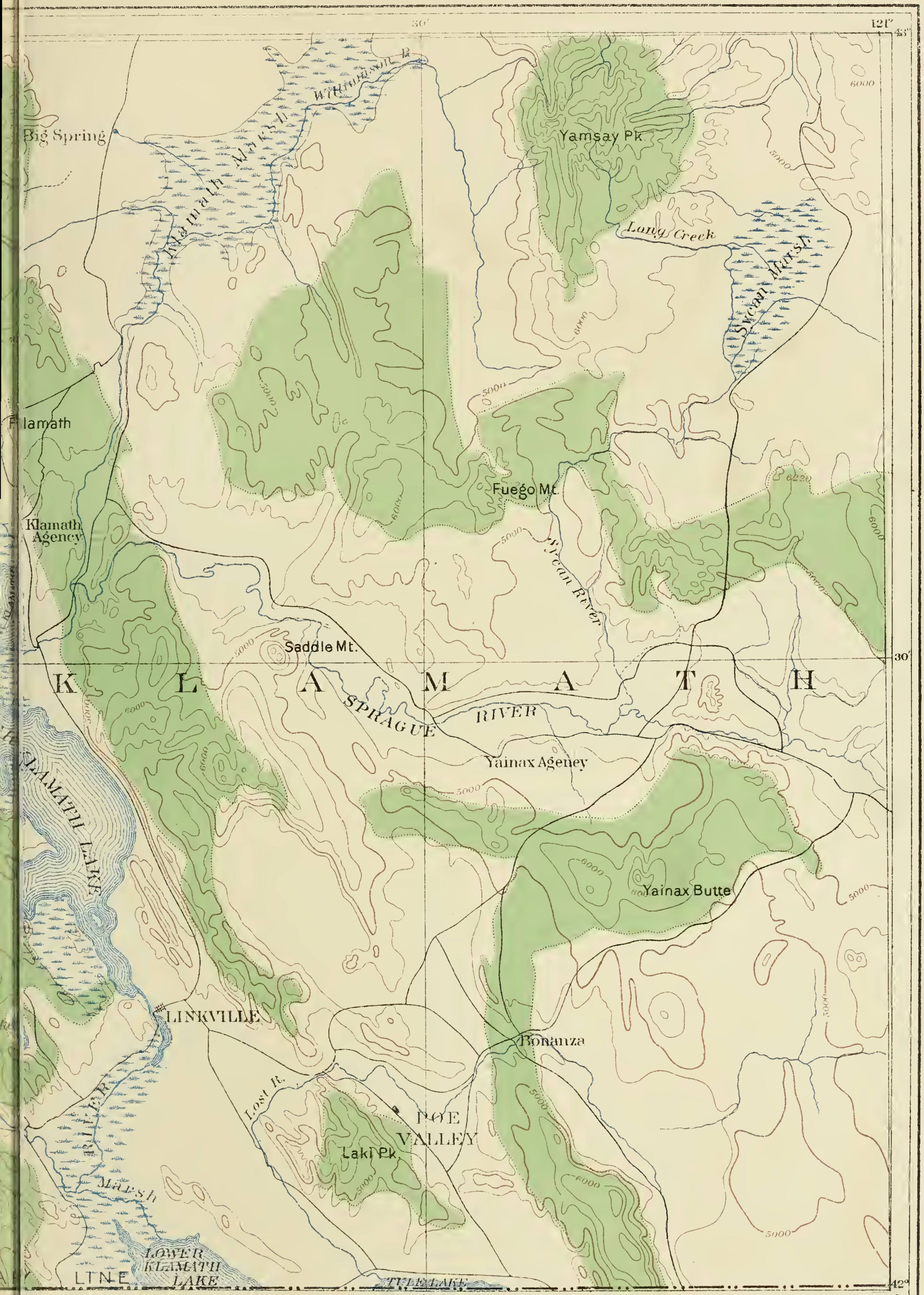

JULIUS BIEN & CO. LITH. N.Y.

G DISTRIBUTION OF WHITE FIR

annett, Geographer in charge

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changes in definite figures and terms, for want of sufficient observations, there can be little doubt that all the modifications and variations in the forest composition after fires are due here as elsewhere to changes in the annual ratio of soil humidity. At least this explanation will suffice to account for much the larger proportion of the phenomena involved in reforestations in this region.

Fires in the mixed growth or in timber stands where the red fir predominates are frequently followed by great masses of white-fir seedlings, which develop into heavy and dense forest stands, and occupy the ground for a century or more. An example of this kind occurs in T. 37 S., R. 5 E. We here have a forest composed almost wholly of white fir, in the midst of which rise here and there huge veterans of red fir 400 to 500 years old. The white fir is a reforestation, a hundred years old, following a burn which destroyed a mixed growth in which red fir largely predominated. Notwithstanding the fact that large numbers of seed trees of red fir escaped destruction, this species was quite unable again to occupy the ground as the first forest growth after the fire.

In the region around the eastern base of Mount Pitt, along the upper limit of the growth of the red fir, reforestations sometimes come in which are almost wholly composed of white pine. This species, while a normal component of the mixed growth in the upper subhumid and the lower humid areas of this region, occurs only as scattered trees barely holding their own among the surrounding masses of red, noble, and white firs. Its sudden ascendancy on certain burned-over tracts is wholly inexplicable. It is not owing to a preponderance of seed trees, for seed trees of the various firs are always much more numerous. Nor is it owing to tolerance, for there are many other burned-over places just as open and free from shade, where adjacent seed trees of the white pine are quite as plentiful. In the south-central areas of T. 33 S., R. 3 E., occur similar reforestations of white pine following burned stands of red and white firs. Here as elsewhere the white-pine seed trees were in the minority, white and red firs predominating.

The central areas of Ts. 31 and 32 S., R. 3 E., carry dense stands of old-growth forest, normally composed of a preponderance of red fir with varying percentages of white fir, western hemlock, white pine, sugar pine, and yellow pine forming the remainder. The soil is a pumice detritus resting on vesicular, much fissured lava; hence in a condition to part with its moisture readily and quickly. The solidity of this old growth is broken in many places by old burns more or less completely reforested. The reforestations are mostly, and sometimes wholly, composed of yellow pine, although this species forms under normal conditions the smallest percentage of any of the trees in the surrounding old-growth forest. Where the yellow-pine reforestations have reached an age of 200 years and upward, the yellow pine is giving way to the encroaching red-fir growth. Where fires of modern date have burned away the yellow-pine reforestations in these places, lodgepole pine or brush growths have taken possession.

While no absolute rule can be formulated to cover all the various phenomena in reforestations after fires, it can nevertheless be said that as a general and broad rule the following is applicable to the forest conditions in this region outside the pure yellow-pine growths on the eastern side of the Cascades: The tendency of all reforestations after fires in the humid and subhumid forest types is to form *pure-growth* stands of the species naturally occurring in the region, the condition or ratio of soil humidity, an ever-varying factor, determining the particular species. The abundance or scarcity of seed trees and the degree of tolerance possessed by the various species are factors of trifling importance.

Growths after fires on the eastern side of the Cascades in pure yellow-pine forest may either be brush or timber. When timber, the reforestations are usually lodgepole pine. Sometimes the growth is a nearly pure stand of white fir. This happens on slopes and flats so situated that they become the recipients of an extra amount of seepage due to accelerated drainage from burned-over tracts at higher levels. Brush growths after fires are due to induced semiarid conditions. Many of the yellow-pine stands east of the Cascades abut upon areas where semiarid or almost true arid conditions obtain. The balance between subhumid and semiarid states often is so nicely adjusted that but a slight change of equilibrium is necessary to effect a permanent change. Where, in such places, fire has lessened the ratio of soil humidity, permanent brush growths usually take the place of the forest. In the big lodgepole-pine reforestations bordering Sycan and Klamath marshes, fires usually leave permanent open areas on which a scant grass growth or scattered brush of semiarid types of vegetation maintains a precarious existence.

On the western side of the Cascades there are comparatively few areas carrying pure stands of yellow pine. Most of the yellow-pine growth is more or less mixed with varying proportions of red fir. Fires in the lower and drier areas of this type of forest are commonly followed by increased growth of various kinds of ceanothus, manzanita, and brush-like or truly arborescent forms of madroña (*Arbutus menziesii*). Sometimes in the upper areas of the subhumid and in the lower portions of the humid tracts fires, instead of being followed by reforestations, give rise to enormously dense brush growths. Tracts of this sort are found in scattered patches everywhere along the middle elevations on the western side of the Cascades, and throughout the Siskiyou Range in the region examined. The most conspicuous examples occur from Mount Pitt northward, in Ts. 36, 35, 34, 33, 32, 31, and 30 S., R. 4 E. The forest, previous to the burns, which are of recent origin, consisted chiefly of red, white, and noble firs. On a nearly continuous area comprising 58,600 acres the forest has been burned to the extent of 98 per cent, and has been supplanted by brush growths which have every appearance of permanency on the larger proportion of the area. The southern half of the burned district carries the densest stands of brush; in the northern the growths are more scattered. In the former the brush is composed of shrubby chinquapin, service berry, manzanita, scrub oaks, vellum-leaved ceanothus, *Garrya*, and willow. In the latter of huckleberry, blackberry, and various species of ceanothus. The northern areas contain a patch here and there which shows feeble signs of reforestation. The southern tracts present solid masses of brush, comparable to the chaparral slopes in southern California, but even more impassable than they. The brush growths are mostly on slopes facing the west or the south; exactly the situations in which the lowering of soil humidity would be most severely felt.

In T. 40 S., R. 3 E., are large brush-covered tracts following the destruction of a nearly pure growth of red fir. The brush is largely composed of *Ceanothus sanguineus*.

It is, of course, impossible to say with absolute certainty that forest will never again replace such brush growths. Situated as they are, within zones of medium precipitation, the chances are naturally favorable for a return of the forest. But these brush growths are at least 30 years old, and as yet exhibit no evidence of change. We may therefore conclude with a great deal of certainty, that although a return to forest may be the ultimate destiny of these firmly established brush growths the event will be very long delayed. In T. 33 S., R. 3 E., occurs a number of stands of very old madroña scattered among a massive old-growth forest chiefly composed of red fir, with smaller proportions of white pine, sugar pine, western hemlock, and Pacific yew. The madroña is not a tolerant tree. Its chief place is among open yellow-pine and red-fir stands, or alone in thickets of manzanita or mixed with oak copses. Yet in this locality we find it growing in company with such trees as the Pacific yew, the most tolerant tree in the arboreal flora of the north Pacific slope. The only explanation which suggests itself is this: That ages ago the present growth of red fir was preceded by brush growths or scattered stands of yellow pine, supposedly due to fires changing the soil humidity. During this period of subhumidity or semiaridity the madroña may have come into the flora in this locality, persisting throughout the changes involving a return to greater ratios of soil humidity. The madroña in this locality is composed of old trees. Several were observed 75 feet in height and 2 feet in diameter. The reproduction of it here has practically ceased. If the supposition now advanced to account for the presence of the madroña in such an incongruous place of growth be the true one, there is at least a basis for the further supposition that the vast and densely brush-covered tracts stretching northward from Mount Pitt along the higher flanks of the Cascades may likewise again recover their former forested condition.

Another after-effect of fires consists in the substitution of grass-covered tracts for the former forest cover. This feature may be observed everywhere along the upper slopes and summits of the Cascades and the Siskiyous in this region. The growth is often grass, but much more commonly it is low-growing mountain sedges or a mixture of both. Where soil humidity permits, the growth becomes matted and forms a more or less continuous turf. More often it is scattered either in circumscribed patches or in isolated tufts. The sedges usually form the turfy places while the grasses occur in isolated bunches, or both sedges and grasses grow in tufts, depending on what species make up the growth. These grassed-over places are, and have been, of commercial importance since the upper plateaus and summits of the Cascades began to be utilized for sheep pastures. All of these pastures and meadows which owe their origin to fires are merely temporary affairs. If suffered to remain undisturbed by further fires they will return to forest cover. Around Diamond and Crater lakes the grassy places are slowly giving way to stands of lodgepole pine as the primary reforestation. On the lava plateaus flanking the crest of the range in Ts. 34 and 35 S., R. 5 E., grassy places created by fires before the advent of the white man have, in course of time, become covered with thick stands of lodgepole pine, now mature and giving way to stands of noble fir and alpine hemlock. During the first reforestation of lodgepole pine the grass and sedge may persist until the crop of this species matures and gives way to other kinds of trees, but with the advent of the noble fir and the alpine hemlock the grass and sedge growth commonly disappears.

A noticeable feature in connection with the after-effects of forest fires in the yellow-pine type of forest is the suppression of undergrowth and of seedling trees. The yellow pine is by all odds the best fire-resisting tree in the sylva of the North Pacific slope. Repeated conflagrations may run through stands of the yellow-pine type without serious damage to the older trees of this species, provided the litter and humus be not too great. But the fires, even should they be of no great force or intensity, work irreparable injury to the seedling trees. On the eastern side of the Cascades, especially, fires have run through the yellow-pine timber many times. The absence or relative scarcity of young growth and underbrush is here very noticeable and striking. Much of the region examined east of the Cascades is included within the boundaries of the Klamath Indian Reservation, and the red man has therefore been under no particular restraint in the matter of burning his timber. In late years it seems to have dawned on his intelligence that good yellow pine may have some value after all, and in consequence fires are set much less frequently than formerly, with the result that where the forest has enjoyed freedom from fire for a number of years seedling and sapling trees of the yellow pine are springing up in the greatest abundance.

Having traced the more salient effects of fires, so far as they are connected with the reproduction and composition of the forest, there remains to be noticed the results of fires as affecting the value of the timber for commercial purposes on tracts which have been subjected to a more or less intense and destructive conflagration.

The amount of damage to the mill timber in a forest stand in this region which may be wrought by a fire varies considerably. It may run as low as 1 per cent in stands of yellow pine, or it may rise so high in stands of mixed growth that it practically amounts to total destruction. In this report a certain area has been segregated under the term "badly" burned. It comprises the tracts upon which the mill timber has been burned away entirely or to the extent of 75 per cent. Out of a total of 2,975,000 acres fire marked in this region 19.5 per cent, or 587,000 acres, are badly burned.

It is, of course, impossible to say with absolute certainty that so and so many million feet were destroyed in these fires, because we can not now ascertain the original density of the forest on the burned-over areas. Especially is this the case on the tracts termed badly burned. But assuming that the fire-swept areas were timbered as heavy proportionately as those that remain, it is safe to reckon the destruction as equal to 35 per cent of the standing timber, as estimated by the standard of "Michigan practice." Expressed in feet B. M. it amounts to 7,000 million in round numbers. This estimate is conservative, and errs, if at all, in placing it too low. As a rule, the areas upon which the destruction has been total, or approximately so, are situated in the heaviest timber, or are in localities where the heaviest timber would be expected to occur. Thus along the upper and middle slopes of the Umpqua ridges are many tracts which, before the fires, carried 60,000 to 70,000 feet of mill timber per acre. On some the timber is all dead, or practically so; on others there are 10,000 to 15,000 feet remaining. The dead timber still stands and can readily be estimated. On the other hand, in the yellow-pine stands the damage has not been so great. In this type of forest much red fir has undoubtedly been destroyed on the western side of the Cascades and much white fir on the eastern side of the range, if we may judge by the nonforested brush-covered spots so common throughout the yellow-pine stands in many localities, but the chief damage consists in the extensive searing and scarring of the yellow pine in the lower half of the trunk, the most valuable portion of the tree.

Of the 7,000 million feet of mill timber destroyed, 5 per cent, or 350 million feet, can clearly be traced as the work of Indians—at least most of it has been burned on the areas embraced within the boundaries of the Klamath Reservation, and the inference that fires in this region were set by the Indians is fully warranted. The balance, or 6,500 million feet, can safely be charged against the white man.

To summarize the fire destruction in the region under consideration, it may be said that, not including clearings for purposes of settlements, the timber on 3 million acres, a total of 7,000 million feet of merchantable mill timber, has been destroyed within the past thirty-five or forty years.

The amount of damage inflicted on growing timber by a fire depends chiefly on the three following factors: (1) The time of the year in which the fire burns; (2) the quantity of litter or humus on the forest floor; (3) the fire-resisting capacity of the different species of trees. In the region under consideration the comparative lack of the second of these factors plays the chief rôle. Humus, as applied to a layer of decaying vegetable débris on the forest floor, is not, as a rule, of any great depth in the forests of these regions. In stands of the yellow-pine type it is a mere thin sprinkling of pine needles. In stands of red fir or mixed growth it is from 2 inches to 3, or, rarely, 4 inches in depth, but is reinforced by a more or less abundant litter of broken trees and branches, naturally shed or torn off by snow or wind. To the light humus layer and the small quantity of litter, more than to any other cause, is due the preservation of the forest from total destruction on these areas. Had there been, for example, the same depth of humus and an equal quantity of litter as in the timbered areas of northern Idaho the region would have been practically deforested by this time. It is not due to lack of fires that any timber remains.

The manner in which fire affects the individual tree varies with the fire-resisting capacity of the species. Here, as elsewhere, the yellow pine both as an individual and as a species stands at the head of the list. A fire in stands of this species runs rapidly, burns low, and with no great intensity owing to the extremely light humus cover. So long as the thick bark, which is a characteristic feature of the species, remains intact, the tree is tolerably safe, but sooner or later, either through the effects of repeated fires or through some accidental injury opening the bark and causing an exudation of resin, fire finds its way into the trunk and produces a fire sear or scar. Each subsequent fire enlarges the burned spot until the tree finally succumbs. The yellow pine in the stands east of the Cascades is much more resinous than on the western slopes, and is therefore much more exposed to destruction by fire. The custom of the Indians of peeling the yellow pine at certain seasons of the year to obtain the cambium layer which they use for food, is in some localities a fruitful contributory cause toward destruction of the yellow pine by fire. They do not carry the peeling process far enough to girdle the tree, but they remove a large enough piece of bark to make a gaping wound which never heals over and which furnishes an excellent entrance for fire. Throughout the forests on the Klamath Reservation trees barked in this manner are very common. Along the eastern margin of Klamath Marsh they are found by the thousands.

The stands of yellow pine which occur so plentifully along the middle elevations on the western slopes of the Cascades are rarely pure growths, but are more or less mixed with other species, among which red and white firs form a large percentage. These kinds commonly occur in scattered aggregations and have not nearly the fire-resisting capacity which distinguishes the yellow pine. When a fire comes along such aggregations become centers for very hot fires, which easily wipe out the adjacent yellow pine. The greatest menace to the yellow-pine forest west of the Cascades, outside of logging practices, is found in these scattered aggregations of poor fire-resisting trees.

The sugar pine has not the fire endurance possessed by the yellow pine. Its usual habitat among masses of red and white fir contributes to its destruction. The root system and the lower portion of the trunk are far more resinous than the balance of the tree and are therefore the most vulnerable. In stands of sugar pine swept by fire one always finds large numbers of trees of this species prostrate on the ground, the lower 6 or 8 feet of the trunk burned away and great gaping holes in the ground where the fire has followed the root system. Often only the heartwood burns out in the lower 8 or 10 feet and one sees huge trees 6 to 8 feet in diameter standing on a few thin stilts of sapwood. Forest fires are especially destructive to this species, not alone in the burning of the large and mature growth, but also because the tree appears incapable of reproducing itself to any great extent on burned-over areas, if one may judge from the few seedlings growing on such tracts.

The white pine is easily destroyed by fire. Its bark is thin, its fire endurance is low, and it always grows where the stands of other species are dense and where the forest floor is covered with a maximum of humus and litter. There is but little of the species in the region. Freedom from fires will enlarge its range to some extent; the reverse will contract it with the result that the species will ultimately become extinct in this region.

The lodgepole pine resists fire poorly. The variety which has its habitat on dry ground is the worst in this respect; the swamp variety has greater endurance, but neither of them possesses it in any considerable degree. The bark is thin and in the upland variety plentifully supplied with small resin particles. Fires most generally kill the tree by burning the bark and the foliage. The trunk remains standing until wind and snow throw it down.

The red fir endures fire to a moderate degree. The mature tree has a greater power in this respect than has the sapling or middle-aged individual. This is due, as much as to any other cause, to the circumstance that in the young and middle-aged tree the resin vesicles in the bark are surficial or nearly so, while in the veterans the resin vesicles have become obliterated or are sunk so deeply in the bark on the lower portion of the trunk that the heat of an ordinary forest fire is not sufficient to flame them. The red fir has suffered severely from both ancient and modern fires. While at the present time it covers a larger area on the western side of the Cascades than any other single species, it formerly was even more abundant. The restriction of its area is partly due to forest fires, which have promoted the growth of other species, chiefly the white fir, at the expense of the former red-fir tracts. Its reproduction, while abundant enough on certain areas, is yet, on the whole, indefinite. A burned-over red-fir tract is almost as likely to grow up to a stand of white fir as to the other.

The white fir resists fire poorly, being in this respect on a par with the great silver fir of the regions farther northward. As a matter of fact there are no essential differences between the great silver fir and the white fir as it grows here, either botanically or in the timber qualities or in its general vegetative behavior. Like the red fir, the young white fir is more susceptible to fire than are the veterans, and for the very same reason, namely, the relative position of the resin vesicles of the bark. The white fir has been badly burned both on the eastern and on the western slopes of the range. In fires among stands of timber where it forms any considerable percentage of the growth it is sure to suffer more damage in proportion to its numbers than any of the other species. Its reproduction is generally good, but in some localities on the eastern side of the range, as T. 32 S., R. 6 E., brush growths are replacing burned or partially burned stands of the white fir.

The noble fir holds an intermediate position between the red and white firs as regards its fire-resisting capacity. Its tendency is toward small aggregations in the midst of mixed growths of other species; but occasionally one meets with considerable stands of nearly pure growth, as along the higher elevations of the Siskiyou Mountains, in T. 41 S., R. 2 W. to 1 E., inclusive. The habit of the species of growing in such clumps or dense aggregations invites more certain destruction by fire than would be the case if it grew singly or scattered. Its reproduction after fires is moderate or below the average of the other species of firs.

The alpine hemlock succumbs easily to fire. Except in very old individuals the bark is thin and is easily scorched beyond recovery. Its habit of growth inclines strongly toward stands and groupings of pure growth or nearly so. Often, however, it forms a mixed growth, with the noble fir as the other chief component. These groupings and mixtures aid in its destruction by fire. Trees of the species have the remarkable habit, after being fire killed, of first decaying half way between the top and the ground. This causes the upper portion of the tree to break off with the first strong wind, and there soon piles up a vast quantity of highly inflammable litter, which insures the complete destruction of all forest on that area when fire reaches it. The destruction that has been wrought in the mixed stands of noble fir and alpine hemlock has been enormous. Especially has this been the case on the upper slopes of the Rogue River-Umpqua divide, where heavy growths of such mixed stands frequently carry as much as 70,000 feet B. M. merchantable timber per acre. Many such tracts on the Umpqua ridges have been laid waste by conflagrations of modern times, which have left nothing of the former forest but dead and blackened stumps.

The western hemlock and Engelmann spruce are both thin-barked trees and stand fire poorly. They are not abundant in the region, and as their reproductive powers are not very good the area occupied by them is continually being restricted by successive fires.

The incense cedar is deficient in fire-resisting qualities. The larger and even the younger trees of the species are almost always rotten at the core. If fire gains entrance to the dry, punky interior the tree is destroyed.

The madroña succumbs easily to fire. It, however, springs up again from the root.

The oaks in the region resist fire well, notwithstanding the fact that more than 50 per cent have a rotten and hollow interior. Their ability to withstand fire is, however, more largely due to environment than to inherent qualities. Their growth is always open and scattered and their habitat is along the lowest elevations, where there is a minimum of combustible material on the ground to support a hot and lasting fire.

CASCADE RANGE FOREST RESERVE AND ADJACENT REGIONS.

BOUNDARIES OF CASCADE RANGE FOREST RESERVE.

Beginning at the meander corner at the intersection of the range line between ranges six (6) and seven (7) east, township two (2) north, Willamette meridian, Oregon, with the mean high-water mark on the south bank of the Columbia River in said State; thence northeasterly along said mean high-water mark to its intersection with the township line between townships two (2) and three (3) north; thence easterly along said township line to the northeast corner of township two (2) north, range eight (8) east; thence southerly along the range line between ranges eight (8) and nine (9) east, to the southwest corner of township two (2) north, range nine (9) east; thence westerly along the township line between townships one (1) and two (2) north, to the northwest corner of township one (1) north, range nine (9) east; thence southerly along the range line between ranges eight (8) and nine (9) east, to the southwest corner of township one (1) north, range nine (9) east; thence easterly along the base line to the northeast corner of township one (1) south, range ten (10) east; thence southerly along the range line between ranges ten (10) and eleven (11) east, to the southeast corner of township four (4) south, range ten (10) east; thence westerly along the township line between townships four (4) and five (5) south, to the southwest corner of township four (4) south, range nine (9) east; thence southerly along the west boundary of township five (5) south, range nine (9) east, to its intersection with the west boundary of the Warm Springs Indian Reservation; thence southwesterly along said Indian reservation boundary to the southwest corner of said reservation; thence southeasterly along the south boundary of said Indian reservation to a point on the north line of section three (3), township twelve (12) south, range nine (9) east, where said boundary crosses the township line between townships eleven (11) and twelve (12) south, range nine (9) east; thence easterly to the northeast corner of township twelve (12) south, range nine (9) east; thence southerly along the range line between ranges nine (9) and ten (10) east, to the southeast corner of township thirteen (13) south, range nine (9) east; thence westerly along the third (3rd) standard parallel south, to the northeast corner of township fourteen (14) south, range nine (9) east; thence southerly along the range line between ranges nine (9) and ten (10) east, to the southeast corner of township fifteen (15) south, range nine (9) east; thence easterly along the third (3rd) standard parallel south, to the northeast corner of township sixteen (16) south, range nine (9) east; thence southerly along the range line between ranges nine (9) and ten (10) east, to the southeast corner of township twenty (20) south, range nine (9) east; thence easterly along the fourth (4th) standard parallel south, to the northeast corner of township twenty-one (21) south, range nine (9) east; thence southerly along the range line between ranges nine (9) and ten (10) east, to the southeast corner of township twenty-three (23) south, range nine (9) east; thence westerly along the township line between townships twenty-three (23) and twenty-four (24) south, to the southeast corner of township twenty-three (23) south, range six (6) east; thence southerly along the range line between ranges six (6) and seven (7) east, to the southwest corner of township twenty-five (25) south, range seven (7) east; thence westerly along the fifth (5th) standard parallel south, to the point for the northwest corner of township twenty-six (26) south, range seven (7) east; thence southerly along the surveyed and unsurveyed west boundaries of townships twenty-six (26), twenty-seven (27), twenty-eight (28), twenty-nine (29), and thirty (30) south, to the southwest corner of township thirty (30) south, range seven (7) east; thence westerly along the unsurveyed sixth (6th) standard parallel south, to the point for the northwest corner of township thirty-one (31) south, range seven and one-half (7½) east; thence southerly along the surveyed and unsurveyed west boundaries of townships thirty-one (31), thirty-two (32), and thirty-three (33) south, range seven and one-half (7½) east, to the southwest corner of township thirty-three (33) south, range seven and one-half (7½) east; thence easterly along the township line between townships thirty-three (33) and thirty-four (34) south, to the northeast corner of township thirty-four (34) south, range six (6) east; thence southerly along the east boundaries of townships thirty-four (34) and thirty-five (35) south, range six (6) east, to the point of intersection of the east boundary of township thirty-five (35) south, range six (6) east, with the west shore of Upper Klamath Lake; thence along said shore of said lake to its intersection with the range line between ranges six (6) and seven (7) east, in township thirty-six (36) south; thence southerly along the range line between ranges six (6) and seven (7) east, to the southeast corner of township thirty-seven (37) south, range six (6) east; thence westerly along the township line between townships thirty-seven (37) and thirty-eight (38) south, to the southwest corner of township thirty-seven (37) south, range four (4) east; thence northerly along the range line between ranges three (3) and four (4) east, to the northwest corner of township thirty-six (36) south, range four (4) east; thence easterly along the eighth (8th) standard parallel south, to the southwest corner of township thirty-five (35) south, range four (4) east; thence northerly along the range line between ranges three (3) and four (4) east, to the southwest corner of township thirty-one (31) south, range four (4) east; thence westerly along the township line between townships thirty-one (31) and thirty-two (32) south, to the southwest corner of township thirty-one (31) south, range one (1) east; thence northerly along the surveyed and unsurveyed Willamette meridian to the northwest corner of township twenty (20) south, range one (1) east; thence easterly along the township line between townships nineteen (19) and twenty (20) south, to the northeast corner of township twenty (20) south, range one (1) east; thence northerly along the range line between ranges one (1) and two (2) east, to the northwest corner of township eighteen (18) south, range two (2) east; thence easterly along the township line between townships seventeen (17) and eighteen (18) south, to the southeast corner of township seventeen (17) south, range two (2) east; thence northerly along the range line between ranges two (2) and three (3) east, to the southwest corner of township seventeen (17) south, range three (3) east; thence easterly along the surveyed and unsurveyed township line between townships seventeen (17) and eighteen (18) south, to the point for the southeast corner of township seventeen (17) south, range four (4) east; thence northerly along the surveyed and unsurveyed range line between ranges four (4) and five (5) east, subject to the proper easterly or westerly offsets on the third (3rd), second (2nd), and first (1st) standard parallels south, to the northwest corner of township five (5) south, range five (5) east; thence easterly along the township line between townships four (4) and five (5) south, to the southeast corner of township four (4) south, range six (6) east; thence northerly along the range line between ranges six (6) and seven (7) east, to the northwest corner of township four (4) south, range seven (7) east; thence easterly along the township line between townships three (3) and four (4) south, to the southwest corner of section thirty-four (34), township three (3) south, range seven (7) east; thence northerly along the surveyed and unsurveyed section line between sections thirty-three (33) and thirty-four (34), twenty-seven (27) and twenty-eight (28), twenty-one (21) and twenty-two (22), fifteen (15) and sixteen (16), nine (9) and ten (10), and three (3) and four (4), to the northwest corner of section three (3) of said township and range; thence easterly along the surveyed and unsurveyed township line between townships two (2) and three (3) south, to the point for the southeast corner of township two (2) south, range eight (8) east; thence northerly along the unsurveyed range line between ranges eight (8) and nine (9) east, to the southeast corner of township one (1) south, range eight (8) east; thence westerly along the township line between townships one (1) and two (2) south, to the southeast corner of section thirty-four (34), township one (1) south, range eight (8) east; thence northerly along the section line between sections thirty-four (34) and thirty-five (35), twenty-six (26) and twenty-seven (27), and twenty-two (22) and twenty-three (23), to the northeast corner of section twenty-two (22); thence westerly along the section line between sections fifteen (15) and twenty-two (22), to the southeast corner of section sixteen (16); thence northerly on the section line between sections fifteen (15) and sixteen (16), to the point for the northeast corner of section sixteen (16); thence westerly along the section line between sections nine (9) and sixteen (16) to the southeast corner of section eight (8); thence northerly along the section line between sections eight (8) and nine (9) and four (4) and five (5) to the northwest corner of section four (4), township one (1) south, range eight (8) east; thence easterly along the base line to the southeast corner of section thirty-three (33), township one (1) north, range eight (8) east; thence along the unsurveyed section lines northerly to the point for the northeast corner of section thirty-three (33), westerly to the point for the northeast corner of section thirty-two (32), northerly to the point for the northeast corner of section eight (8), westerly to the point for the southwest corner of section six (6); thence northerly along the unsurveyed range line between ranges seven (7) and eight (8) east, to the point for the northwest corner of township one (1) north, range eight (8) east; thence westerly along the unsurveyed township line between townships one (1) and two (2) north, to the northwest corner of township one (1) north, range seven (7) east; thence northerly along the surveyed and unsurveyed range line between ranges six (6) and seven (7) east, to the meander corner at its intersection with the mean high-water mark on the south bank of the Columbia River, the place of beginning.

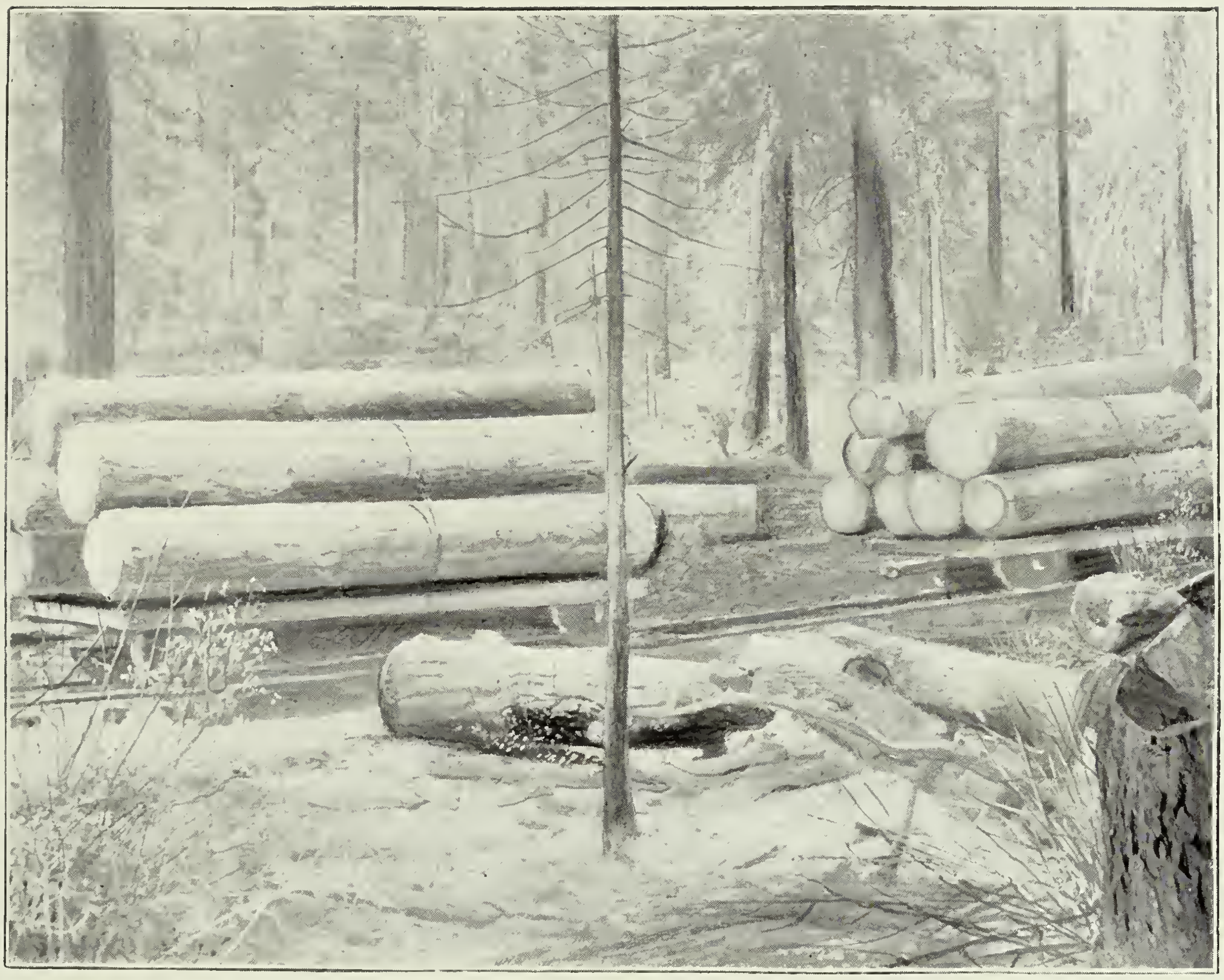
CHARACTER OF REGION.

The area embraced in this examination covers 838,400 acres, situated within the boundaries of the Cascade Range Forest Reserve. It comprises most of the reserve south of the north line of T. 28 S., the exceptions being T. 28 S., Rs. 1, 2, and 3 E., and T. 29 S., Rs. 1 and 2 E.

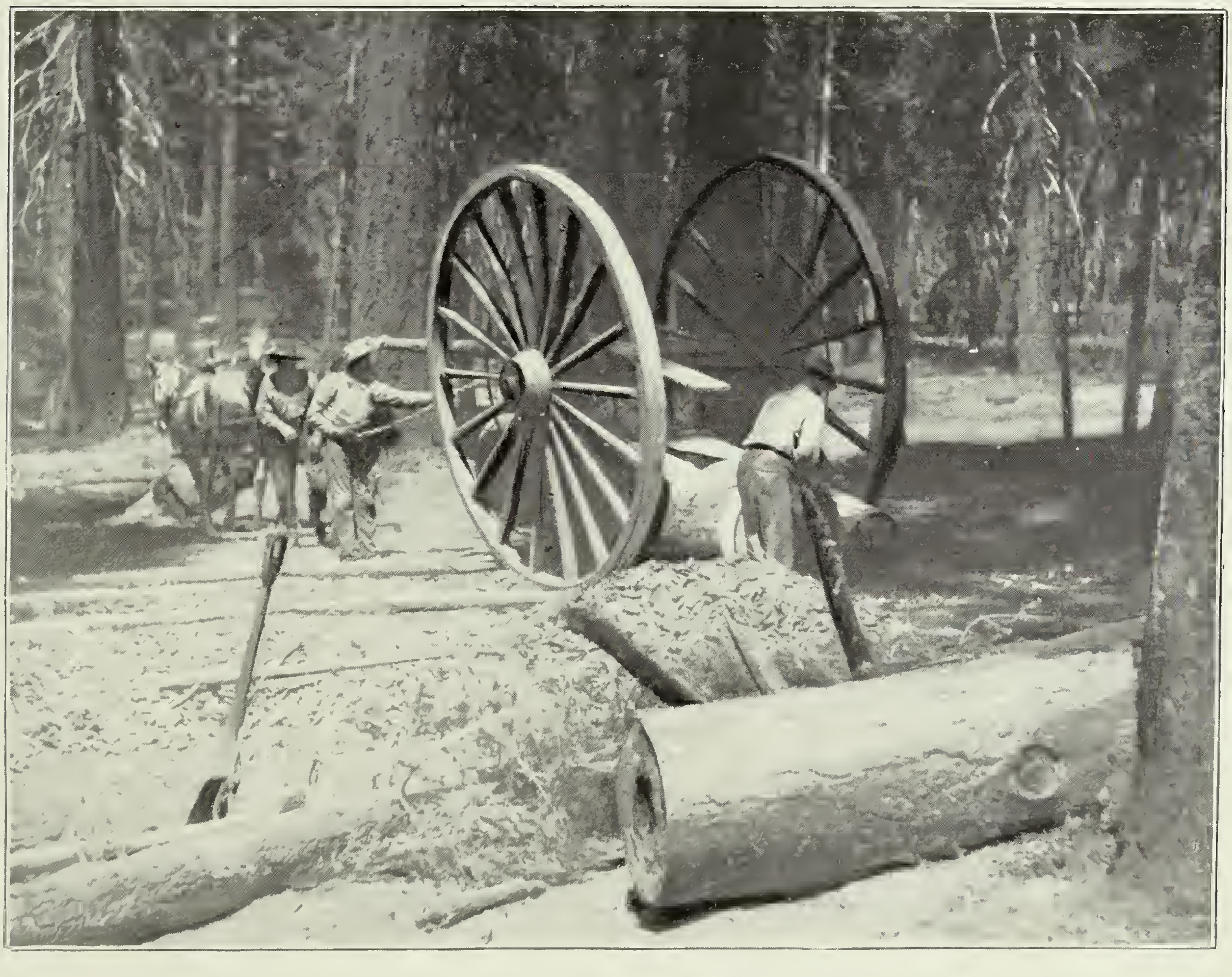
From the north line of T. 38 S., which forms the south boundary of the reserve, to the south line of T. 31 S. the reserve has a width of 18 miles, comprising three ranges of townships, namely, 4, 5, and 6 E., with the crest line of the Cascade Range nearly in the center of the area. North of the south line of T. 31 S. the boundaries of the reserve are extended westward to the Willamette meridian line and eastward a distance of about 4 miles, the westward enlargement covering the drainage from the Umpqua-Rogue River divide from the west line of T. 31 S. to the junction of the divide with the Cascade Range.

The reserve in this region consists of rocky and mountainous tracts, with altitudes varying from 4,500 to nearly 10,000 feet above sea level. The Cascades and a portion of the Umpqua-Rogue River divide, near its junction with the former range, are of volcanic origin, the crest lines studded at frequent intervals with extinct volcanic cones and peaks, the slopes covered with thick deposits of lava, some very ancient, some comparatively recent, and in many localities overlain by vast sheets of fine or coarse pumice ejected from nearby vents. In the central and southern portions the Umpqua-Rogue River divide is of volcanic nature only in places, much of it being made up of the more ancient porphyry core which lies at the base of the Cascades.

Most of the water flowing from the region finds its way into Rogue River. On the northern slopes of the Umpqua-Rogue River divide a small quantity empties into the South Umpqua. The western boundaries of the reserve are so arranged that they very accurately cover the heads of all the more important affluents of the Rogue River system. South of T. 33 S. most of the streams head in very large springs, which suddenly burst out from under thick lava flows; north of that township the stream heads lie in marshy areas or originate in small and scattered springs. The canyons are generally narrow and rocky. The larger ones have repeatedly been dammed by lava flows, through which the streams have cut fresh channels, with resultant gorges and falls. In the pumice-covered areas many of the



A. LOGGING TRACKS AND LOAD, NEAR SNOW, T. 40 S., R. 5 E.



B. METHOD USED IN HAULING LOGS TO THE LOGGING RAILROAD AT SNOW, T. 40 S., R. 5 E.

streams lie in narrow canyons, sunk 400 to 500 feet in loose pumiceous material.

On the eastern side of the Cascades the reserve boundaries cover the heads of a number of small creeks. With the exception of Anna Creek and Wood River, none of them are of any importance. The waters of these two streams are utilized for irrigation purposes.

The region is essentially a forested one. It contains a few heavily timbered tracts, a considerable area, in the aggregate, lightly forested, and large tracts that carry only thin and scattered groups of trees. With the exception of rocky tracts naturally without soil, areas above timber line, lake, and marshes, not a large area collectively, the thinly wooded and nonforested tracts owe their origin in ninety-nine cases out of a hundred to forest fires.

All of the three general forest types previously described in this report are found in the reserve. The yellow-pine type is sparingly represented. The red-fir and the alpine-hemlock types are abundant and of characteristic composition.

The Cascade Range Forest Reserve in its entirety possesses extremely varied features of topography and forest conditions. Until more extended examinations shall have been made it can not be treated in a manner to satisfactorily show the correlation of its various portions. Pending such examination, the region covered in the field work during the season of 1899 is here described by minor subdivisions, the township having been chosen as the unit of area.

In the tabulations of areal and timber estimates accompanying each township is to be noted that the term "forested areas" includes all tracts carrying an arborescent growth, which, in many places where fires have badly burned the forest, is often very thin or scattering, or at subalpine elevations, where rocky soil and severe climatic conditions negative the existence of a continuous forest, consists of trees set far apart, with bare ground between. In the term "nonforested" it has been the aim to include all tracts containing 20 acres and upward wholly bare of arborescent growth. Tracts with less than 20 acres are included under "forested areas" (Pl. LXXXI, *A* and *B*).

DETAILED DESCRIPTIONS.

Township 28 South, Range 5 East.

This township is situated on the summit of the main range of the Cascades. Its southern and central portions consist of an almost level pumice plain. The northern sections comprise high ridges, which here and there rise into prominent peaks, all of which are extinct volcanic cones. These ridges and peaks constitute the junction point of the main range of the Cascades and the Umpqua-Rogue River divide.

The southern areas have no visible run-off. The northern discharge limited quantities of water partly by way of tributaries to the South Umpqua, partly into Diamond Lake, whence it finds its way to the North Umpqua.

There are no agricultural lands, and no mineral-bearing areas are known in the township.

The grazing lands consist of fire glades along the west shore of Diamond Lake, whose southern end barely touches the township. The glades constitute in part the great sheep ranges of the high Cascades, which extend northward from this and the next township on the east.

The forest is of the alpine-hemlock type. The southern and central portions are covered with stands of lodgepole pine, all reforestations after fires and representative of all ages of burns from one hundred and fifty years ago up to the present time. There is no portion of these or of the heavier stands of alpine hemlock and noble fir in the northern sections of the township that have not been visited by fire within the past forty-five years. Reforestations consist wholly of lodgepole pine as the first growth. In some places on warm southern declivities brush growth comes in after fires. In other localities a grass and sedge sward covers the ground. It is clearly evident that many of the fires have been set for the purpose of promoting these grass growths and enlarging the possible sheep range. It is also noticeable that wherever fires have been kept down for four or five years there is a gradual return to forest and a disappearance of the grass. As before remarked, it is essential to the maintenance of the stability of the waterheads in the pumice-covered regions of the high Cascades that the pumice cover be disturbed as little as possible. To this end reforestations should be encouraged in every possible manner, even at the expense of destroying the grass and sedge swards by allowing the forest to regain possession.

The mill timber is of poor quality and is confined to the northern sections of the township, where it is inaccessible for logging operations.

Timbered and other areas in T. 28 S., R. 5 E., Oregon.

	Acres.
Forested area	23,040
Badly burned area	18,000
Logged area	None.

Total stand of timber in T. 28 S., R. 5 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
White pine	16.7	5,000,000	5,000,000
Noble fir	66.7	20,000,000	25,000,000
Alpine hemlock	16.6	5,000,000	10,000,000
Total	....	30,000,000	40,000,000

Composition of forest in T. 28 S., R. 5 E., Oregon, including all species with diameters of 4 inches and upward.

	Per cent.
Lodgepole pine	80
Noble fir	10
Alpine hemlock	9.2
White pine	.8

Township 28 South, Range 6 East.

The areas comprised within the lines of this township are situated on the summit of the main range of the Cascades. The southern and central areas consist of a nearly level pumice-covered region. The northern sections are rocky with numerous ridges stretching westward from Mount Thielsen, an extinct volcanic center occupying the northeast corner of the township. About two sections in the northeast corner are comprised in Diamond Lake, and an additional two sections in a series of swamps at its southern extremity. There is practically no visible drainage originating in the township. A large stream heading in T. 28 S., R. 4 E., flows through it and empties into Diamond Lake.

There are no agricultural and no mineral lands in the township. There is a large amount of grazing land, consisting in part of fire glades and in part of 1,200 acres of marsh and overflowed land at the south end of Diamond Lake. The dry tracts are all used for sheep range.

The forest consists of stands of alpine-hemlock type. Ninety per cent of it is composed of lodgepole-pine reforestations. Some of these stands date back to the Indian occupancy, others are the result of fires set by the white man. All of the forest is fire marked. Reforestations after fires are invariably composed of lodgepole pine. Repeated conflagrations and total destruction of the forest bring grass and sedge growths. Fires in the township have been fewer during the past four or five years than formerly, and most of the grassy tracts are slowly reforesting.

The mill timber is of poor quality and is confined to the spurs of Mount Thielsen. It exists in small scattered bodies and is inaccessible for logging operations.

Forested and other lands in T. 28 S., R. 6 E., Oregon.

	Acres.
Forested area	18,000
Badly burned area	15,000
Nonforested area (lake, swamps, bare rocks, etc)	5,040
Logged area	None.

Total stand of timber in T. 28 S., R. 6 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Noble fir	60	3,000,000	3,000,000
Alpine hemlock	40	2,000,000	2,000,000
Total		5,000,000	5,000,000

Composition of forest in T. 28 S., R. 6 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Lodgepole pine	95
Noble fir	3
Alpine hemlock	2

Township 28 South, Range 6½ East.

This township is situated wholly on the eastern slope of the Cascades. The northwestern portion consists of steep spurs radiating from Mount Thielsen; the central and southern tracts comprise a long gradual slope from the summit of the range to its eastern foot. The township is only partly included in the forest reserve, the area outside the reserve containing about 16,000 acres, but included in the estimates is a narrow strip adjoining the Klamath Indian Reservation, which brings the acreage up to that of a full township.

The township is drained by three small creeks rising in springs and marshy places at the foot of the range and sinking in the pumice deposit in the adjoining township to the east.

No agricultural, grazing, or mineral lands occur on the tract.

The forest consists of stands of yellow-pine and alpine-hemlock types. The alpine-hemlock type here is composed almost entirely of lodgepole-pine stands, which are reforestations after fires, and occupy the western half of the township. The eastern half is covered with yellow pine of mature age, running from 5,000 to 10,000 feet B. M. per acre.

The forest is fire marked everywhere in the township. Seventy-five per cent of the yellow pine is fire seared in the lower 3 or 4 feet of the trunk. Reforestations are moderate, but the burned tracts in the yellow pine show a tendency to grow up to lodgepole pine.

The region carrying the mill timber is easy of access for logging in any direction except over the range from the west.

The areal and timber estimates are as follows:

Forested and other areas in T. 28 S., R. 6½ E., Oregon.

	Acres.
Forested area	23,040
Badly burned area	12,000
Logged area	None.

Total stand of timber in T. 28 S., R. 6½ E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	146,000,000	161,280,000

Composition of forest in T. 28 S., R. 6½ E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Lodgepole pine	75
Yellow pine	25

Township 28 South, Range 7 East.

This township is situated east of the main range of the Cascades, and consists chiefly of easy slopes or nearly level tracts. The surface is covered with a soil of pumice detritus.

The entire township is fire marked. The complexion of the present forest growth is largely owing to fires during the exclusive Indian occupancy. Result of fires is lodgepole-pine growths where sufficient soil moisture exists; in other localities growths of scattered desert shrubs, tufts of grass, or small and insignificant weeds.

The mill timber is mostly confined to the southwestern areas. It is mostly fire scarred on the lower one-quarter of the trunk. It otherwise is fair in quality and is easy of access. Owing to suppression of young growth by repeated fires it is largely composed of standards and veterans.

Forested and other areas in T. 28 S., R. 7 E., Oregon.

	Acres.
Forested area	23,040
Logged area	None.

Total stand of timber in T. 28 S., R. 7 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	20,000,000	26,880,000

Composition of forest in T. 28 S., R. 7 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Lodgepole pine	88
Yellow pine	12

TOWNSHIP 28 SOUTH, RANGE 8 EAST.

This township is situated east of the Cascades, and comprises a nearly level tract of country. The general flatness is relieved here and there by low benches, marking the recedence of what now constitutes Klamath Marsh. The soil is uniformly a pumice detritus, fine on the surface as a rule, but composed of irregular blocks and fragments below.

The forest is chiefly lodgepole pine. The mill timber, which is all yellow pine, occurs singly or in very small groups scattered throughout the body of lodgepole pine. It is poor in quality, and is composed wholly of standards and veterans. It clearly is a remnant of a much more extensive stand which covered the region anterior to the lodgepole growths. The preponderance of the latter species is wholly due to forest fires during the Indian occupancy, that is to say, before the coming of the white man, as this township lies within the Klamath Indian Reservation, in part.

The lodgepole-pine growth has been reburned here and there within recent times. The result of such reburning is, almost invariably, the creation of sparsely grassed, absolutely nonforested areas.

Forested areas in T. 28 S., R. 8 E., Oregon.

	Acres.
Forested area	23, 040
Logged area	None.

Total stand of timber in T. 28 S., R. 8 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	1, 500, 000	1, 500, 000

Composition of the forest in T. 28 S., R. 8 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Lodgepole pine	99. 9
Yellow pine	. 1

TOWNSHIP 29 SOUTH, RANGE 3 EAST.

The northern and central portions of this township consist of high ridges belonging to the northern slopes of the Umpqua-Rogue River divide. The southern areas comprise tracts with comparatively low relief, constituting parts of the upper drainage basin of the North Fork of Rogue River. A deposit of pumice covers the southern sections, while the northern have only a light covering of this material or, in many places, are entirely free of it.

The volume of run-off from the township is very large. Most of it is discharged into the South Umpqua, a smaller portion going into Rogue River through the north fork of this stream. The Umpqua-Rogue River divide that here supplies most of the run-off is not of the same volcanic formation as the Cascades. It evidently is much less fissured and therefore sheds a great deal more of the precipitation as visible drainage.

The township contains no agricultural land. Mineral-bearing ground has been discovered in various localities along the crest and slopes of the Umpqua-Rogue River divide. Along the summits and flanks of the higher ridges is a considerable quantity of grazing land which is utilized for sheep range. The grazing areas consist wholly of fire glades or of rocky slopes which have not reforested after fires.

The forest consists of stands of red-fir and alpine-hemlock types. It is fire marked throughout.

Reforestations are composed chiefly of lodgepole pine, in the stands of which the grass and sedge swards that came in after the fires persist for a long time. In some localities, especially where fires have been particularly destructive, brush growths, composed of the vellum-leaved ceanothus, occupy the ground.

The mill timber is of poor quality and is generally defective, owing to the numerous fires that have swept through the township during the past 40 or 45 years. Most of it is inaccessible for logging operations; but a small quantity in the southern sections can be reached by way of the valley of the North Fork of Rogue River.

Forested and other areas in T. 29 S., R. 3 E., Oregon.

	Acres.
Forested area	23,040
Badly burned area	10,000
Logged area	None.

Total stand of timber in T. 29 S., R. 3 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
White pine	10	4,000,000	4,000,000
Red fir	62.5	25,000,000	40,000,000
White fir	12.5	5,000,000	10,000,000
Alpine hemlock	15	6,000,000	11,000,000
Total		40,000,000	65,000,000

Composition of forest in T. 29 S., R. 3 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Red fir	50
White fir	10
White pine	5
Alpine hemlock	30
Lodgepole pine	5

Township 29 South, Range 4 East.

The northern half of this township is situated on the northern slopes of the Umpqua-Rogue River divide, and consists of high, rocky ridges. The southern half comprises pumice-covered levels intersected by low ridges of lava and furrowed by numerous small deep canyons, which form the upper heads of the eastern tributaries of the North Fork of Rogue River.

The run-off from the northern half of the township is large in volume, and flows into the South Umpqua. The quantity originating in the other half is of moderate volume, and empties into Rogue River through the North Fork.

There are no agricultural lands in the township. Mineral-bearing areas have been discovered along the northern slopes of the Umpqua-Rogue River divide, and some claims have been located. The region, in common with other mineral ground along this divide, carries values only in gold. The thinly wooded areas on the summits of the Umpqua ridges constitute the grazing lands of the township. Some of them are naturally thinly forested or wooded; others are grassed over as the result of fires.

The forest consists of red-fir and of alpine-hemlock stands. Most of the stands are reforestations; some after fires since the white man's occupancy; others after fires that burned while the Indians were in possession. Sixty per cent of the reforestations are composed of lodgepole pine; the balance of alpine hemlock and white pine.

The mill timber is poor in quality and of small dimensions throughout. It is inaccessible for logging operations.

The areal and timber estimates for the township are as follows:

Forested and other areas in T. 29 S., R. 4 E., Oregon.

	Acres.
Forested area	23,040
Badly burned area	18,000
Logged area	None.

Total stand of timber in T. 29 S., R. 4 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B.M.*
White pine	31.3	5,000,000	5,000,000
Red fir	50	8,000,000	10,000,000
White fir	18.7	3,000,000	10,000,000
Total		16,000,000	25,000,000

Composition of forest in T. 29 S., R. 4 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Lodgepole pine	80
Red fir	8
White fir	5
White pine	3
Alpine hemlock	4

TOWNSHIP 29 SOUTH, RANGE 5 EAST.

This township comprises areas situated on the summit and immediate western slopes of the main range of the Cascades. Most of the tract consists of level or gently sloping areas, all very deeply pumice covered. In the northern portion of the township there are four or five sections of high, mountainous ridges belonging to the Umpqua-Rogue River divide.

The water supply of this township is trifling in amount. Most of the precipitation sinks in the immense sheet of pumice and disappears. The heads of two of the lesser tributaries of the North Fork of Rogue River lie in the central portions of the township. Each has cut out a deep but narrow canyon in the pumice. It is evident that in late years these streams have cut into the pumice at a more rapid rate than they formerly did. The widespread destruction of the growing forest by fire has no doubt contributed to this acceleration. If it be desirable to prevent the vast blanket of pumice along the summit and higher slopes of the Cascades from transfer to the low-lying valleys of the agricultural districts, it is necessary that everything tending toward the loosening of the pumice surface should be avoided.

The forest is of the alpine-hemlock type. It consists of lodgepole pine with small groups of alpine hemlock and noble fir scattered here and there among the lodgepole. The species represent reforestation after fires. This region was burned periodically during the Indian occupancy, as the many different ages represented in the lodgepole-pine stands prove. But when the white man came into the region the areas in this particular township were covered with a uniform stand of the species. During the past forty or forty-five years the timber has been burned in many localities and the subsequent reforestations have again been burned. The region is too high in altitude to permit the growth of much brush. After a fire one of three things happens; either lodgepole pine comes as the first forest growth, or grasses and sedges form a thin, interrupted sward, or the ground remains bare of all vegetation. It is impossible to predict beforehand which one of the three phases will appear. It all depends on the extent to which the ratio of soil moisture has been disturbed and changed.

The township contains no mill timber. There are no agricultural, grazing, or mineral lands in the township.

The areal estimates are as follows:

Forested and other areas in T. 29 S., R. 5 E., Oregon.

	Acres.
Forested area	23,040
Badly burned area	18,000
Logged area	None.

TOWNSHIP 29 SOUTH, RANGE 7 EAST.

This township is situated on the eastern side of the Cascades and consists of nearly level plains in the eastern portions and of gentle slopes, rising toward the Cascades, in the western. The soil is uniformly a pumice sand.

The forest in the eastern areas consists of lodgepole pine, reforestations after ancient fires. In the western sections of the township the timber is yellow pine mixed with lodgepole. The western areas are fire marked throughout. The lodgepole in the eastern portions does not form a solid stand. It is everywhere broken by small, scantily grassed tracts, which for some reason, possibly lack of soil humidity, do not reforest.

The mill timber is of fair quality, and is mostly composed of standards and veterans. Reproduction in the yellow-pine stands is good where fire has not run for a number of years.

Forested and other areas in T. 29 S., R. 7 E., Oregon.

	Acres.
Forested area	23,040
Badly burned area	None.
Logged area	None.

Total stand of timber in T. 29 S., R. 7 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	68,540,000	80,640,000

Composition of forest in T. 29 S., R. 7 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent
Lodgepole pine	90
Yellow pine	10

TOWNSHIP 29 SOUTH, RANGE 8 EAST.

This township consists of nearly level, pumice-covered plains, situated between the eastern foot of the Cascades and the northern end of Klamath Marsh.

The forest is almost exclusively a lodgepole-pine growth, here, as in most places along the eastern base of the Cascades, representing a reforestation after ancient fires. The nonforested tracts are sparsely grassed areas that have failed to reforest.

The mill timber consists mostly of single trees or of groups of a dozen or two scattered among the lodgepole. It is inferior in quality, and is practically worthless for commercial purposes.

Forested and other areas in T. 29 S., R. 8 E., Oregon.

	Acres.
Forested area	20,000
Nonforested area (meadows)	3,040
Badly burned area	None.
Logged area	None.

Total stand of timber in T. 29 S., R. 8 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	6,000,000	6,000,000

Composition of forest in T. 29 S., R. 8 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Lodgepole pine	99.9
Yellow pine	.1

TOWNSHIP 30 SOUTH, RANGE 2 WEST.

This township is estimated from information, as it was not personally examined.

	Acres.
Area forested and wooded	23,040

Total stand of timber in T. 30 S., R. 2 W., Oregon.

	Feet B. M.
Yellow pine	45,000,000
Red fir	60,000,000
Sugar pine Incense cedar	18,000,000
Total	123,000,000

TOWNSHIP 30 SOUTH, RANGE 1 WEST.

This township is estimated from information, as it was not personally examined.

	Acres.
Area forested and wooded	23,040

Total stand of timber in T. 30 S., R. 1 W., Oregon.

	Feet B. M.
Yellow pine	25, 000, 000
Red fir	165, 000, 000
Sugar pine Incense cedar	10, 000, 000
Total	200, 000, 000

Township 30 South, Range 1 East.

This township is mostly on the northern slopes of the Umpqua-Rogue River divide, a small portion in the northwest corner covering spurs projecting southward from the ridges between the North Umpqua and South Umpqua excepted. In some places the township consists of long steep spurs; in others, especially in the southeast corner, the ridges have broad summits and easy slopes.

The region contains no grazing or agricultural lands. It is more or less mineral bearing throughout most of its areas, but as yet there are no mines or prospects in process of development.

This township has a large run-off. It originates in numerous small creeks that empty into the South Umpqua, which flows through the northwest corner of the township.

The forest consists of stands of yellow-pine, red-fir, and alpine-hemlock types. The yellow-pine type occurs on ridges of low elevation bordering the South Umpqua; the alpine-hemlock type on summits and high slopes along the Umpqua-Rogue River divide; the red-fir type in the canyons and on all of the areas situated at middle elevations.

The stand of timber is heavy throughout, especially along the flanks of the summit of the Umpqua-Rogue River divide, notwithstanding the fact that 50 per cent of all the timber has been visited by fire. Reforestations are abundant and are chiefly composed of red fir.

The mill timber is of good quality. The red-fir, noble-fir, and alpine-hemlock stands are largely composed of standards and veterans. The last two species form very heavy stands on the broad summits and spurs in the southeastern sections of the township. With the exception of the main valley of the South Umpqua, the forest is inaccessible for logging operations.

Forested and other areas in T. 30 S., R. 1 E., Oregon.

	Acres.
Forested area	23, 040
Badly burned area	2, 500
Logged area	None.

Total stand of timber in T. 30 S., R. 1 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	19.1	45,000,000	59,685,000
Sugar pine	2.8	6,000,000	7,958,000
Red fir	59.7	131,000,000	250,677,000
White fir	1.5	3,000,000	7,958,000
Noble fir	10	20,000,000	39,790,000
Alpine hemlock	6.9	15,000,000	31,832,000
Total		220,000,000	397,900,000

Composition of forest in T. 30 S., R. 1 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	20
Sugar pine	.4
Red fir	60
White fir	3
Noble fir	10
Alpine hemlock	6.5

TOWNSHIP 30 SOUTH, RANGE 2 EAST.

This township is situated partly on the northern and partly on the southern slopes of the Umpqua-Rogue River divide, which almost bisects the township, entering near the northeast corner and leaving near the southwest. The portion of the crest of the divide which lies within the township generally is rocky, narrow, and very tortuous, and slopes abruptly on either side to canyons of great depth. About midway in the township the crest expands into Abbots Butte, a mass of volcanic rock with an elevation of 6,500 feet. The summit of the butte is flattened, with a projecting central, rocky boss. It is about three-fourths of a mile in width and breaks off on all sides, except at one point in the northwest corner, with a precipitous wall of rock 400 to 1,500 feet in height. The sections of the township situated on either side of the Umpqua-Rogue River divide are filled with steep, precipitous spurs.

The volume of water discharged by the stream in the southern portions of the township is small and empties into the North Fork of Rogue River. The outflow from the northern areas is large and enters the South Umpqua. The areas draining into this stream are copiously supplied with large, springy, marshy tracts, situated on the sloping hillsides and at the heads of the various creeks.

The township has no agricultural land. Most of its areas are known to be mineralized, and four or five mineral claims are located on the

Umpqua-Rogue River divide a mile west of Abbots Butte. There is no development work in progress on these claims or on any others in the township.

The grazing lands consist of glades scattered throughout the summit areas and higher slopes of the Umpqua-Rogue River divide. These glades are mostly due to forest fires burning off the timber. A small number of cattle occasionally stray up here from the lowlands of the Rogue River Valley in late summer. The summit of Abbots Butte and most of the high slopes of the divide east and north of this point are used for pasturing sheep.

The forest consists of stands belonging to the three types of the region. The yellow-pine type occurs chiefly in the southwestern areas. In the northern sections there also are considerable quantities of yellow pine, but it scarcely forms a type, the species and its associates existing as scattered trees or in small groups among the red-fir stands. The alpine hemlock is the forest along the summit and higher slopes of the Umpqua-Rogue River divide. It also extends downward on the northern declivities of the divide to the 4,000-foot contour line, following the numerous wet canyon bottoms and slopes. The stands of the type are often of great density, reaching 50,000 to 75,000 feet B. M. per acre. The red fir is chiefly composed of standards, much of it running above 3 feet basal diameter and having clear trunks 60 to 90 feet in length. There are mixed with the red-fir type, and sometimes with the alpine-hemlock type as well, scattered trees and small aggregations of sugar and white pine, the individuals averaging 2 to 6 feet in diameter at the base and 40 to 90 feet in length in the clear trunk.

The region around Abbots Butte is noteworthy because it is the most southerly station known in the Cascades for the Alaskan cedar. The species occurs in a few localities on the slopes of and adjoining the butte as scattered individuals in the mass of alpine-hemlock forest, occasionally forming aggregations with 300 to 400 individuals in a close growth. The species is a small tree or large shrub as it grows here, and is of no commercial value whatever.

The forest is fire marked throughout the township and 15 per cent of the standing mill timber has been consumed or killed. It is worthy of note that although the forest on the northern slopes of the Umpqua-Rogue River divide in this and the preceding township has been overrun by fire almost everywhere, the actual quantity of timber consumed is not nearly as large as might be expected considering the extent of the fires. It is doubtless due to the generally wet condition of the humus and litter that more has not been destroyed. The fires have been more severe and widespread along the summit of the divide, where the sheep pastures are found, than elsewhere. As fires in these localities decidedly encourage grass growth at the expense of the forest, there probably is some connection between the sheep camps and the fires that have ravaged the timber in their neighborhood.

The burned-over areas in the township do not reforest rapidly or well. The tendency is toward grassy glades rather than to forest at all the higher elevations, and to dense brush growths at the lower and middle altitudes. Some of the slopes covered with pumice, or with small lapilli, are being denuded of their soil down to the lava bed rock as a result of the fires and the consequent loosening of the forest floor.

The portion of the township south of the Umpqua-Rogue River divide, about one-third of its entire area, can be logged from the Rogue River Valley, although with some difficulty. The balance of the township is inaccessible for logging operations.

Forested and other areas in T. 30 S., R. 2 E., Oregon.

	Acres.
Forested area	21, 040
Nonforested area (burned)	2, 000
Logged area	None.
Badly burned area	3, 500

Total stand of timber in T. 30 S., R. 2 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	11. 2	20, 000, 000	25, 654, 400
Sugar pine	5. 6	10, 000, 000	16, 896, 000
White pine	. 9	2, 000, 000	3, 379, 200
Red fir	61. 2	110, 000, 000	209, 889, 600
White fir			3, 379, 200
Noble fir	10	18, 000, 000	41, 550, 400
Incense cedar			1, 689, 600
Alpine hemlock	11. 1	20, 000, 000	33, 792, 000
Western hemlock			1, 689, 600
Total		180, 000, 000	337, 920, 000

Composition of forest in T. 30 S., R. 2 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	10
Sugar pine	3
White pine	Inconsiderable.
Incense cedar	Inconsiderable.
Western hemlock	Inconsiderable.
Alpine hemlock	13
Red fir	60
White fir	2
Noble fir	10
Alpine fir	Inconsiderable.
Pacific yew	Inconsiderable.
Yellow cedar	Inconsiderable.

Township 30 South, Range 3 East.

The western sections of this township are situated on the southern slopes of the Umpqua-Rogue River divide. The eastern areas comprise in part the valley bottoms of the North Fork of Rogue River and in part low broad spurs projecting westward from the main range of the Cascades, which form a sort of plateau region.

The ridges extending from the Umpqua divide in the western portion of the township are steep and rocky and inclose broad terraced creek bottoms at frequent intervals. The valley of the North Fork of Rogue River is a depression about 2 miles wide and 600 to 800 feet in depth. The valley, so far as it lies in this township, has been scooped out through an immense deposit of pumice and exhibits from 4 to 6 distinct terraces. The terraces on the eastern side of the stream are generally wider than those on the west. In the southern portions of the township the stream has in some places cut through the pumice deposit to the underlying lava bed rock, causing narrows and rapids to form in the channel, which elsewhere is broad and smooth.

The streams originating in the township are of small volume. They are chiefly springs which break out along the slopes of the different terraces west of the river. The springs represent a portion of the seepage coming from the slopes of the Umpqua-Rogue River divide. Although these springs discharge but a trifling amount of water, they have nevertheless succeeded in excavating deep channels through the pumice terraces between the points of issue and their entrance into the river. Some of these channels are 200 feet in depth. In time the entire pumice deposit on the west side of the river will be transported into the bed of the stream through the agency of these springs and the rivulets originating from them.

There are no agricultural lands in the township. Mineral-bearing areas are known to occur in the ridges of the Umpqua-Rogue River divide.

The grazing areas consist of marshy flats and fire glades bordering Rogue River. They occur in the south-central areas of the township and cover in the aggregate 500 or 600 acres.

The forest consists of three types. The yellow-pine type is not well developed, and exists chiefly as scattered groups among the red-fir stands and on the lower ridges in the southwest corner of the township. Most of the heavy forest is on the terraces in the bottoms of the North Fork. It is chiefly stands of red-fir type containing an unusually large percentage of noble fir. Most of the mill timber consists of standards and veterans averaging from 2 to 4 feet in diameter with clear trunks 45 to 75 feet in length. The alpine-hemlock type occurs in the extreme eastern areas. It is of small dimensions throughout.

The mountainous sections of the western tracts of the township are inaccessible for logging operations. The valley portions can easily be logged, but owing to obstructions in the river bed by ancient lava flows, which come to the surface near the junction with Union Creek, the North Fork can not be used for driving. Above the obstructions the channel is free, broad, and 5 to 6 feet in depth during three or four months of the year.

With the exception of isolated patches of forest along the lower valley terraces, the timber is fire marked throughout the entire township. The damage has been immense. Sixty per cent of the standing mill timber has been consumed, or has been so badly damaged within the past forty-five years that it is unfit for commercial purposes. This involves a loss of 250 million feet B. M. in this one township. Much of the burned-over tracts has reforested with lodgepole pine, which in its turn has been burned of late years to the extent of 25 per cent. As a rule, reforestations are abundant on the valley lands, but are composed of the worthless lodgepole pine. On the slopes and highest terraces it is deficient, immensely dense brush growth of the vellum-leaved ceanothus almost invariably replacing the forest in such localities.

Timbered and other areas in T. 30 S., R. 3 E.

	Acres.
Forested area	19,680
Nonforested area (bare rocks and glades, 1,500; burned area, 1,860)	3,360
Badly burned area	6,000
Logged area	None.

Total stand of timber in T. 30 S., R. 3 E.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	5.3	8,000,000	9,348,000
Sugar pine	6.6	10,000,000	11,686,000
White pine	2	3,000,000	4,674,000
Red fir	73.4	110,000,000	140,232,000
White fir	3.4	5,000,000	23,372,000
Noble fir	8	12,000,000	35,058,000
Incense cedar			700,000
Western hemlock			1,168,600
Alpine hemlock	1.3	2,000,000	7,012,000
Engelmann spruce			469,400
Total		150,000,000	233,720,000

Composition of forest in T. 30 S., R. 3 E., including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	5
Sugar pine	5
White pine	1
Lodgepole pine	10
Red fir	45
White fir	15
Noble fir	10
Incense cedar	.1
Western hemlock	2
Alpine hemlock	5
Engelmann spruce	.1

TOWNSHIP 30 SOUTH, RANGE 4 EAST.

The northern and central portions consist of flats and terraces stretching westward from the main range of the Cascades. They are intersected by lava ridges of low relief and furrowed by canyons 300 to 400 feet in depth cut through the pumice deposit, which deeply covers the entire township. The southern sections comprise a flat tract 2 miles in width stretching across the township from east to west.

The township has scarcely any run-off. The streams that flow through it all have their heads in adjoining townships. These streams carry large volumes of water and empty into the North Fork of Rogue River, which cuts the extreme northwest corner of the township.

There are no grazing, agricultural, or mineral-bearing areas.

The forest consists of stands of yellow-pine, red-fir, and alpine-hemlock types. The yellow pine is of poor quality and occurs as small, scattered groups in the western areas of the township. The red fir is composed largely of standards and veterans, generally of the same class and dimensions as those in the preceding township. Much of the alpine-hemlock type is of small dimensions, being reforestations after fires which burned 90 to 100 years ago. The heaviest stands of forest occur in the northwest sections of the township, on terraces belonging to the valley of the North Fork of Rogue River.

The township is easy of access for logging operations. The streams, however, lie in too deep and narrow canyons and are too much obstructed by rocks to be utilized for driving purposes.

Practically all of the forest is fire marked. One-sixth of the entire area has been burned clean of timber, save for an occasional tree, and the remainder has lost 40 per cent of its mill timber through the same cause. The southern areas have suffered the most, but no tract has been entirely exempt. Brush growths of the vellum-leaved ceanothus follow the fires. In a few localities lodgepole-pine reforestations are beginning to supplant the brush.

Timbered and other areas in T. 30 S., R. 4 E., Oregon.

	Acres.
Forested area	19,740
Nonforested area (burned)	3,300
Badly burned area	3,300
Logged area	None.

Total stand of timber in T. 30 S., R. 4 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	2	2,000,000	4,309,200
Sugar pine	.9	1,000,000	1,077,300
White pine	1	1,000,000	1,077,300
Red fir	78.5	80,000,000	150,822,000
White fir	4.9	5,000,000	30,164,400
Noble fir	9.8	10,000,000	21,546,000
Alpine hemlock	2.9	3,000,000	6,463,800
Total		102,000,000	215,460,000

Composition of forest in T. 30 S., R. 4 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

Yellow pine	3
Sugar pine	.1
White pine	.1
Lodgepole pine	25
Red fir	60
White fir	5
Noble fir	4.8
Alpine hemlock	2

TOWNSHIP 30 SOUTH, RANGE 5 EAST.

This township is situated on the western slope of the Cascades. The crest of the range occupies the eastern areas. It consists of the rocky western rim of Crater Lake, which attains elevations of 8,600 feet above sea level. The crest is narrow, seldom more than 8 to 10 rods in width. On the east it breaks off by precipices 1,200 to 2,000 feet in height to the depression holding Crater Lake. On the west the crest sinks, through a series of steep escarpments, none of great height, to a terraced region, mostly of low relief, which occupies the central and western sections of the township. The entire region, except the peaks and prominent rocky elevations and escarpments along the crest of the range, is deeply buried under a mass of fine pumice.

A large quantity of water flows out of the township. It originates at the base of the crest of the range in a series of springs and marshy tracts. The stream channels in their course westward through the township deepen rapidly and soon form canyons 200 to 300 feet in depth.

There are no agricultural lands in the township. Some of the volcanic scoria, lapilli, and pumice in the western sections of the townsnip are said to have yielded colors of gold; otherwise there are no mineral lands.

The grazing lands consist wholly of fire glades. For many years the areas below the crest were periodically burned by sheep herders, hunters, and campers. As the region is mostly above the line of heavy brush growths, grass and sedge came in and covered the burned-over tracts with a more or less thick sward. Neither cattle nor sheep are pastured in this township at the present time.

Stands of red-fir and alpine-hemlock type form the forest. The red-fir type is the principal growth in the western areas. It is mixed with small percentages of yellow and sugar pine. The central and eastern areas are covered with stands of pure alpine-hemlock type, in which the alpine hemlock occurs as the principal component. The forest along the crest is thin. Much of it exists as small groups separated by bare pumice flats or as scattered trees, in which case such areas might perhaps be more properly classed as wooded than as forested. Elevations above 7,500 feet along the crest are rocky and nearly devoid of arborescent growth, stunted indviduals of the white-bark pine being almost the only denizens of such tracts.

The mill timber is of poor quality except in the western areas, where the red fir forms the principal species in the stands. It can be logged with little difficulty except such as is naturally encountered in a region of high elevation, heavy snowfalls, and severe winters. It is accessible either from the valley of the North Fork of Rogue River or from the Klamath-Crater Lake wagon road, in the southeastern sections of the township.

Most of the township is marked by fire. The stands of alpine hemlock which occur on the crest have been burned only here and there, owing to the surrounding nonforested pumice flats which have acted as fire breaks. Below the crest the forest has been extensively burned. The largest burns of modern date run back 35 or 40 years, but for the last 100 years the forest on the terraces west of Crater Lake has been periodically burned. This is proved by the age of the lodgepole-pine stands. Reforestations of lodgepole pine follow fires at these elevations, and in the present stands of this species groups of all ages up to 100 or 110 years are represented, while decaying remains of the stands burned 35 or 40 years ago show trees of still higher age. In the last three or four years the region has enjoyed comparative immunity from this scourge and the glades are fast reforesting except in a few of the marshy tracts too wet for forest growth.

Forested and other areas in T. 30 S., R. 5 E., Oregon.

	Acres.
Forested area	12,860
Nonforested area (rocks and lake, 6,000; burned area, 4,180)	10,180
Badly burned area	6,500
Logged area	None.

Total stand of timber in T. 30 S., R. 5 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	11.1	1,000,000	1,300,000
Sugar pine	7.8	700,000	700,000
Red fir	44.4	4,000,000	5,000,000
Noble fir	11.1	1,000,000	4,000,000
Alpine hemlock	25.5	2,300,000	14,040,000
Total		9,000,000	25,040,000

Composition of forest in T. 30 S., R. 5 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	.01
Sugar pine	.01
White pine	.001
White-bark pine	.0001
Lodgepole pine	14
Red fir	8
White fir	.5
Noble fir	11.5
Alpine hemlock	65
Engelmann spruce	.0001

TOWNSHIP 30 SOUTH, RANGE 6 EAST.

Most of this township is occupied by the well-known Crater Lake, being situated on the summit of the Cascades. The waters originating along the eastern and southern rim of the lake flow into the Klamath drainage, while that which rises in the west and north goes into Rogue River. The region is rocky and precipitous, with a mean elevation of nearly 7,000 feet, exclusive of the depression holding the lake. With the exception of a few insignificant springs in the southern areas, there is no visible run-off from the township.

There are no agricultural, grazing, or mineral lands.

The forest is entirely of the alpine-hemlock type. Half of the area is merely wooded, scattered trees or groups of trees separated by pumice flats and rocky combs forming the arborescent growth.

The mill timber is mostly confined to the northern areas of the township and is inferior in quality. A few scattered groves of alpine hemlock occur on the southern tracts. Some of the alpine hemlocks in these stands are of large size, occasional individuals reaching 6 to 7 feet in diameter.

There are fire marks on most of the forest in the southern part of the township. Elsewhere the stands of timber are so thin and scattered that fires have never succeeded in obtaining any sort of a start.

Forested and other areas in T. 30 S., R. 6 E., Oregon.

	Acres.
Forested area	5,080
Nonforested area (rocks and lake)	17,960
Badly burned area	2,500
Crater Lake	12,800
Logged area	None.

Total stand of timber in T. 30 S., R. 6 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Noble fir	33.3	1,000,000	3,000,000
Alpine hemlock	66.7	2,000,000	10,000,000
Engelmann spruce			440,000
Total		3,000,000	13,440,000

Composition of forest in T. 30 S., R. 6 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Lodgepole pine	2
White pine	.0001
White-bark pine	2
Noble fir	.5
Alpine fir	.1
Alpine hemlock	95
Engelmann spruce	.001

Township 30 South, Range 6½ East.

This township is situated on the eastern slopes of the Cascades. The western sections consist of broken, rocky tracks with a mean elevation of 7,000 feet, and contain in the southern areas Mount Scott, an extinct volcanic cone, with an elevation of 9,100 feet. The central and eastern portions comprise a mass of steep, broken ridges and spurs sloping sharply to the levels bordering Klamath Marsh at the foot of the range. The region is volcanic throughout, as is the case with the preceding townships.

A small strip of undetermined width along the eastern edge of the township lies outside the reserve boundaries. If the western boundary of the Klamath Indian Reservation, which here nearly adjoins the forest reserve, should be found to pass along the true east line of the township, the tract now excluded ought to be annexed to the reserve.

With the exception of a few small springs, the region has no visible drainage system.

There are no agricultural, grazing, or mineral lands in the township.

The forest at the lower elevations consists of yellow pine. The stand is of good quality and easy of access from all directions, except from the west.

At the upper edge of the yellow-pine forest along the 5,800-foot contour line begins the alpine-hemlock type. The stands of the type at their lower range are composed of lodgepole pine; at middle altitudes alpine hemlock and noble fir form the forest; while at the highest elevations the tracts are merely wooded with sparse, scattered growth of white-bark pine, alpine fir, and alpine hemlock. Mount Scott projects 600 or 700 feet above timber line.

A great deal of the forest shows fire marks. The entire body of yellow-pine growth has been seared repeatedly. Large fires burned there the past summer. The lodgepole-pine stands at middle elevations are the result of fires which burned before the advent of the white man. Reforestations are nearly always lodgepole pine at all elevations. Brush growths are not common.

Forested and other areas in T. 30 S., R. 6½ E., Oregon.

	Acres.
Forested area	21,040
Nonforested area (bare rocks)	2,000
Badly burned area	5,000
Logged area	None.

Total stand of timber in T. 30 S., R. 6½ E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	72	18,000,000	52,000,000
Noble fir	12	3,000,000	5,600,000
Alpine hemlock	16	4,000,000	7,000,000
White fir			3,000,000
Total		25,000,000	67,600,000

Composition of forest in T. 30 S., R. 6½ E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	60
White pine	Scattered.
White-bark pine	1
Lodgepole pine	15
White fir	1
Noble fir	5
Alpine fir	Scattered.
Alpine hemlock	17.8

TOWNSHIP 30 SOUTH, RANGE 7 EAST.

This township is situated east of the main range of the Cascades and consists of level tracts deeply covered with pumice deposits and of small areas of slope in the western portions which are also pumice covered.

The forest on the level areas is composed of solid lodgepole-pine stands, reforestations after ancient fires; the slopes bear stands of yellow pine with small groups of lodgepole pine and scattered trees of white fir. Fires of recent times have run through the lodgepole-pine stands, and in a lesser degree through the yellow-pine growths. Tendency of fires in the lodgepole pine is to produce scantily grassed, nonforested tracts; in the yellow-pine to favor growths of lodgepole pine.

Mill timber is moderately easy of access, of medium quality, and largely composed of standards and veterans owing to suppression of young growth by the numerous fires.

Forested and other areas in T. 30 S., R. 7 E., Oregon.

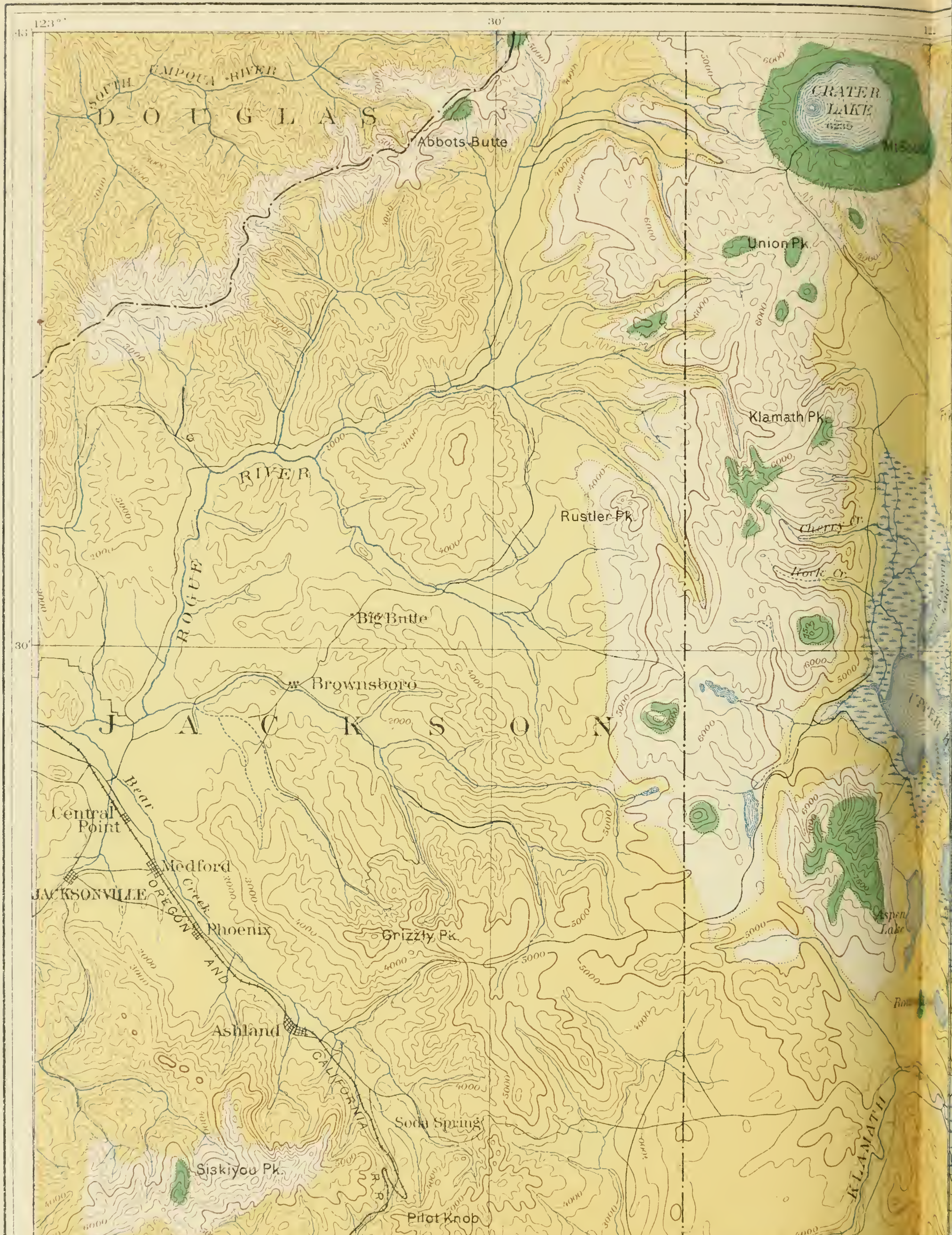
	Acres.
Forested area	23,040
Badly burned area	4,500
Covered with solid stands of noncommercial timber	18,560
Logged area	None.

Total stand of timber in T. 30 S., R. 7 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	25,000,000	33,600,000

Composition of forest in T. 30 S., R. 7 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	12
Lodgepole pine	88
White fir	Occasional trees.



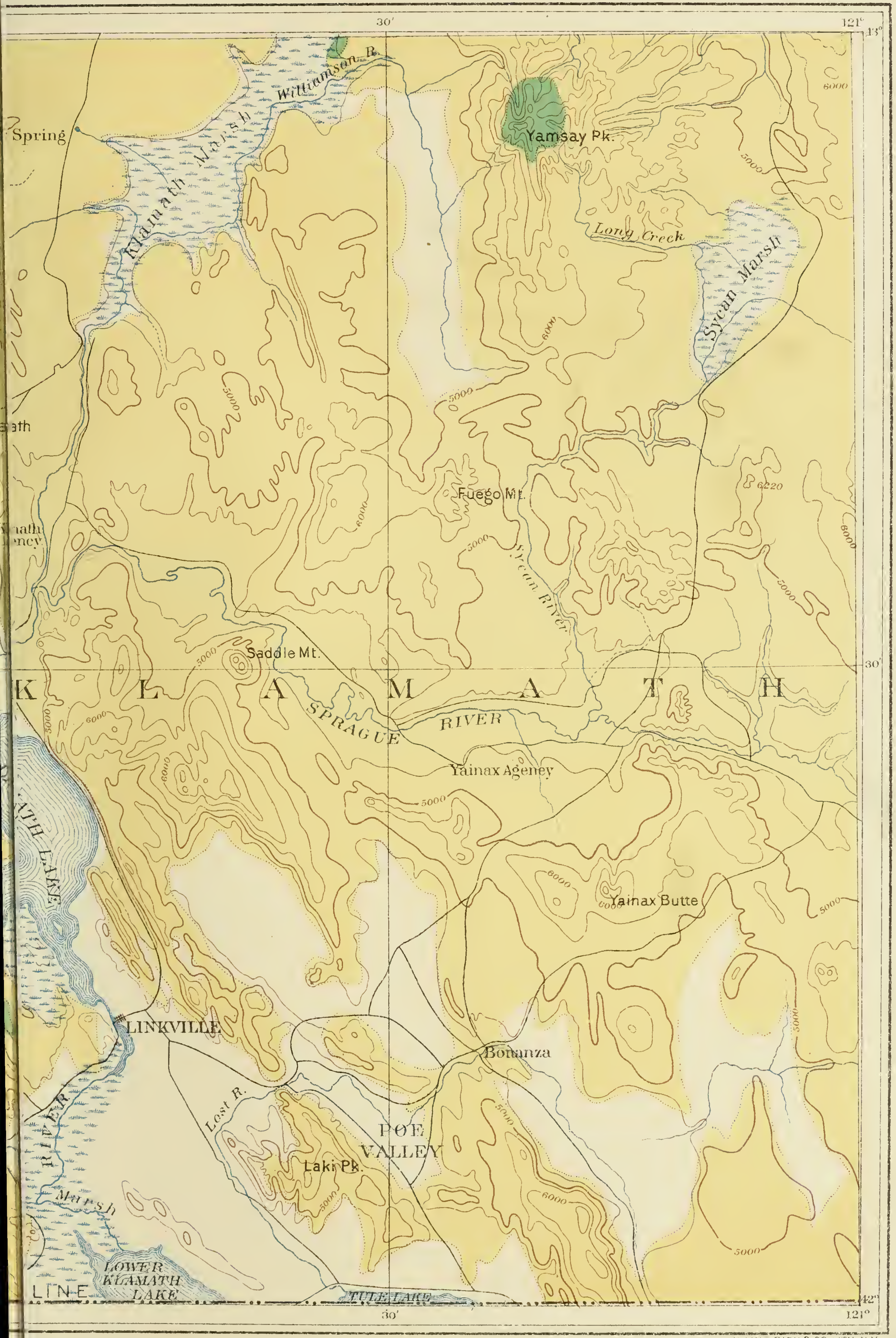
PART OF SOUTHERN OREGON SHOWING DISTRI

Prepared under the direction of H

BY JOHN

🟨 Yellow pine

Contour



JULIUS BIEN & CO. LITH. N.Y.

OF YELLOW PINE AND WHITE BARK PINE

tt, Geographer in charge

16 18 20 MILES

🟩 White bark pine

Township 30 South, Range 8 East.

This township is situated east of the Cascades, the extreme eastern areas being covered by portions of Klamath Marsh, the western tracts consisting of a nearly level pumice-covered plain.

The forest is almost wholly a lodgepole-pine growth, reforestation after ancient fires, except along the edge of the marsh where the lodgepole-pine stands mark the receding line of the wet and swampy ground and constitute the primary forest growth on the emerging land.

Recent fires have marked the lodgepole-pine growths here and there, and in such places there is a decided tendency toward grassy tracts rather than reforestations.

The small quantity of mill timber is scattered through the lodgepole pine. It is of very poor quality, being chiefly remnants of an old forest long since burned.

Forested and other areas in T. 30 S., R. 8 E., Oregon.

	Acres
Forested area	17,280
Nonforested area (Klamath Marsh)	5,760
Logged area	None.

Total stand of timber in T. 30 S., R. 8 E., Oregon.

Species.	Local practice.		Michigan practice.
			Feet B. M.
Yellow pine			2,240,000

Composition of forest in T. 30 S., R. 8 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	0.0001
Lodgepole pine	99.9999

Township 30 South, Range 9 East.

This township is situated east of the Cascades and consists chiefly of tule- and sedge-covered areas belonging to Klamath Marsh. The extreme eastern areas are formed by a projecting spur of lava and bear the forest. Soil is uniformly a pumice deposit.

All of the timber in the township is fire marked. Result of fires is the suppression of young growth, fire scarring of the older, with twisting and bending of the smaller trunks. There is little brush growth throughout. There is no humus, the forest floor being bare, sharp, pumice sand.

Mill timber is easy of access, but poor in quality, and mostly of small dimensions.

Forested and other areas in T. 30 S., R. 9 E., Oregon.

	Acres.
Forested area	6,400
Nonforested area (Klamath Marsh)	16,640
Logged area	None.

Total stand of timber in T. 30 S., R. 9 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	13,000,000	26,240,000

Composition of forest in T. 30 S., R. 9 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	99.5
Lodgepole pine	.5

TOWNSHIP 30 SOUTH, RANGE 10 EAST.

This township is situated east of the Cascades. Its northern portion consists of grassy, nonforested bottom lands bordering the Williamson River, while the southern areas are formed of low lava hills, as a rule deeply covered by a fine pumice deposit.

The forest in the township is fire marked throughout. In late years there has been fewer fires than formerly and the young growth, formerly mostly suppressed, is asserting itself everywhere. The young growth is yellow pine with a few scattered individuals of white fir. The lodgepole pine is found along the swales of the Williamson River bottoms.

Mill timber is very good in quality, being largely composed of standards and veterans with fair, clear trunks. It is easy of access from the Williamson River bottoms and forms, as a whole, a valuable stand of timber.

Forested and other areas in T. 30 S., R. 10 E., Oregon.

	Acres.
Forested area	11,800
Nonforested area (marsh and meadows)	11,240
Logged area	None.

Total stand of timber in T. 30 S., R. 10 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	100,700,000	122,700,000

Composition of forest in T. 30 S., R. 10 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	99.5
Lodgepole pine White fir	.5

Township 30 South, Range 11 East.

This township, situated east of the Cascades, consists in the western areas of nonforested bottom lands bordering the Williamson River, and in the eastern portions of pumice-covered lava slopes which form, in part, the western declivities of the Yamsay Range.

The lower and intermediate slopes carry good stands of yellow pine bordered along the marshy areas of the Williamson bottoms by narrow fringes of lodgepole pine. The upper slopes of the range bear chiefly lodgepole pine and white fir. Fires have marked the forest everywhere throughout the township.

The mill timber is easy of access and is of good, clear body, largely composed of standards and veterans.

Forested and other lands in T. 30 S., R. 11 E., Oregon.

Forested area	15,340
Nonforested area (glades and meadows)	7,700
Logged area	None.

Total stand of timber in T. 30 S., R. 11 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	80,000,000	93,700,000
White fir			3,740,000
Total		80,000,000	97,440,000

Composition of forest in T. 30 S., R. 11 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

Yellow pine	70
Lodgepole pine	20
White fir	10

Township 30 South, Range 12 East.

This township forms the eastern slopes of the Yamsay Range, an ancient volcanic center. The areas are rocky and broken, and along the upper slope the forest has largely been burned and replaced by brush growths. This township was not examined personally, but was estimated from information.

Forested and other areas in T. 30 S., R. 12 E., Oregon.

	Acres.
Forested area	11,040
Nonforested area (rocks and glades 5,000, burned 7,000)	12,000
Logged area	None.
Badly burned area	8,000

Total stand of timber in T. 30 S., R. 12 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	20,000,000	35,000,000

Composition of forest in T. 30 S., R. 12 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	75
Lodgepole pine	25

Township 30 South, Range 13 East.

This township was not examined personally, but was estimated from information.

Forested and other areas in T. 30 S., R. 13 E., Oregon.

	Acres.
Forested area	8,040
Nonforested area	15,000
Logged area	None.

Total stand of timber in T. 30 S., R. 13 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	8,000,000	16,000,000

Township 30 South, Range 14 East.

This township was not examined personally, but was estimated from information.

Forested and other areas in T. 30 S., R. 14 E., Oregon.

	Acres.
Forested area	10,040
Nonforested area	13,000
Logged area	None.

Total stand of timber in T. 30 S., R. 14 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	4,000,000	8,000,000

TOWNSHIP 31 SOUTH, RANGE 2 WEST.

Area forested and wooded ... acres..	23,000

Total stand of timber in T. 31 S., R. 2 W., Oregon.

	Feet B. M.
Yellow pine	50,000,000
Red fir	100,000,000
Sugar pine Incense cedar	18,160,000
Total	168,160,000

TOWNSHIP 31 SOUTH, RANGE 1 WEST.

This township consists of portions of the Umpqua-Rogue River divide. It is filled with a mass of north-south spurs, projecting from this divide as a backbone, and is in consequence a steep and, on the whole, inaccessible region for lumbering operations.

The forest is fire marked throughout, having been badly burned along the higher slopes.

Mill timber is mostly confined to the canyon bottoms and the middle elevations. Much of the red fir is of small dimensions and badly fire scarred.

Forested and other areas in T. 31 S., R. 1 W., Oregon.

	Acres.
Forested area	23,040
Badly burned area	8,500
Logged area	None.

Total stand of timber in T. 31 S., R. 1 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	39.3	75,000,000	85,000,000
Sugar pine	4.2	8,000,000	10,000,000
Red fir	52.3	100,000,000	175,000,000
White fir	2.6	5,000,000	25,000,000
Incense cedar	1.5	3,000,000	5,000,000
Total		191,000,000	300,000,000

Township 31 South, Range 1 East.

This township is situated on slopes of the Umpqua-Rogue River divide, a ridge separating the drainage basin of Rogue River from that of the South Umpqua River. The divide enters the township in the northeast corner and strikes through it in a direction a trifle south of west. The position of the township is thus partly on the northern, partly on the southern slopes of the divide. The crest of the ridge is a narrow, rocky hogback, 40 to 50 yards wide in some places, in other localities not more than 3 or 4 yards. In its course through the township it varies in altitude from 4,000 to 5,500 feet. It slopes off very sharply, both on the northern and on the southern declivities. The southern slopes, which form the central and southern areas of the township, consist of a large number of narrow, tortuous ridges, inclosing deep canyons. In general all the canyons in these portions of the township head sharply in the steep slopes of the divide, have narrow bottoms 2 to 4 rods wide, and very steep, often rocky sides. The northern declivities of the divide are similar to the southern, but the canyon bottoms are generally wider.

The run-off of the township is large, and flows away in two directions, namely, northward to South Umpqua River, southward to Rogue River by way of Elk Creek.

There are no agricultural lands in the township. The central portions contain a few hundred acres of grazing lands. They consist of open, park-like ridges, covered with yellow pine, where the scattered timber permits a thin growth of grass to exist. Cattle range on these tracts, but no sheep.

The township adjoins known mineral-bearing areas on the east, north, and west. While, so far, no mineral deposits have been discovered here, it is very probable that prospecting will eventually disclose them on both sides of the divide.

All three of the forest types which occur on the nearby slopes of the Cascades are represented in the township. The yellow-pine type is the prevailing forest at low altitudes on the southern and western slopes of the ridges. The red-fir type occupies the canyon bottoms and moist northern and eastern declivities, while the alpine-hemlock type is limited to the summit and highest slopes of the Umpqua-Rogue River divide.

The yellow-pine type is not abundant or well developed. Its stands are thin and scattering, and the component trees, yellow and sugar pine, are only of medium dimensions—20 to 30 inches in basal diameters, 15 to 20 feet clear trunks. Occasionally, however, there occur veteran sugar pines, remnants of a very old growth, whose diameters vary from 6 to 10 feet. These giants are not very common, and almost every one of them is in a state of decay, due to scars and basal burns of modern times. The red-fir type is abundant and well developed. It occurs of three ages—veterans, standards, and young growth. The veterans are mixed with sugar pine, yellow pine, and white fir, and have dimensions varying from 5 to 9 feet in diameter at the base, with clear trunks 40 to 80 feet in height. The standards occur in extensive bodies throughout the canyon bottoms. The trees average 2 to 3 feet in basal diameters, with clear trunks 40 to 60 feet in length. The young growth represents reforestations after fires which burned the forest one hundred years ago. Stands of this kind are chiefly confined to the northern slopes of the divide, where they appear to have replaced growths of alpine-hemlock type.

The alpine-hemlock type is composed mostly of noble fir and alpine hemlock in almost equal proportions. Previous to fires, originating since the white man's occupancy of the region, the stands of this type were of magnificent proportions. To judge from the remains there were large areas which carried more than 100,000 feet B. M. per acre. The best stands were composed of large veteran trees 2½ to 3½ feet in diameter at the base, with long columnar trunks 50 to 60 feet in the clear. Little remains now but the fire-killed trunks.

Ninety per cent of the forest in the township is fire marked. Forty per cent of the standing timber has been consumed by fire within the past forty-five years, but no area has been burned completely off; there is always some little timber left. Most of the burned-over areas are reforesting, principally with red fir. A few of the southern slopes are becoming brush covered, dense thickets of rhododendron and of vellum-leaved ceanothus occupying the ground.

The southern areas of the township are readily accessible to logging operations by way of the various canyon bottoms. The central portions can be reached only with difficulty, while the summit and higher slopes are practically inaccessible.

Forested and other areas in T. 31 S., R. 1 E., Oregon.

	Acres.
Forested area	23,040
Badly burned area	7,000
Logged area	None.

Total stand of timber in T. 31 S., R. 1 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	8.8	10,000,000	16,500,000
Sugar pine	2.7	3,000,000	3,000,000
Red fir	70.8	80,000,000	160,000,000
Noble fir	7.1	8,000,000	11,000,000
White fir			8,000,000
Incense cedar			620,000
Alpine hemlock	10.6	12,000,000	14,000,000
Total		113,000,000	213,120,000

Composition of forest in T. 31 S., R. 1 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	10
Sugar pine	1
White pine	.005
Lodgepole pine	.5
Incense cedar	.005
Oaks, etc	1
Red fir	60
White fir	6
Noble fir	10
Alpine fir	.0005
Alpine hemlock	10

Township 31 South, Range 2 East.

This township mostly comprises areas on the southern declivities of the Umpqua-Rogue River divide, a small portion in the northwest corner overlapping on the northern side of the ridge. The entire tract consists of a mass of rough, steep, rocky ridges radiating from the Umpqua-Rogue River divide, and inclosing narrow canyons with precipitous slopes. The southern and portions of the central areas consist of volcanic rocks of the same composition as like formations in the Cascades. The northern sections consist chiefly of porphyries and similar ancient eruptive rocks.

The run-off from the township is of small volume. That from the central and western areas reaches Rogue River by way of Elk Creek, while that which originates in the eastern sections flows into North Fork of Rogue River through a number of small creeks.

There are no agricultural lands in the township. The grazing lands consist of small marshy glades at the heads of various streams. Few of the glades are really open or meadow-like; most of them carrying scattered groups of trees. Cattle range throughout the township, subsisting on browse and on the trifling amount of grass the glades are capable of supplying. There are no sheep regularly pastured, but occasionally bands are driven across the township to grazing grounds in the adjoining township on the north, T. 30 S., R. 2 E.

The northwestern portion of the township is mineral bearing, and a number of claims, said to be of promising appearance, have there been lately opened.

The forest consists of stands belonging to the yellow-pine, red-fir, and alpine-hemlock types. The latter type inhabits the region in the northern portion of the township along the summit and upper slopes of the Umpqua-Rogue River divide. The yellow-pine and red-fir types occur on the lower slopes and in the bottoms of canyons.

The western and some of the central portions of the township have been badly burned. No tracts have been swept completely clean, thin stands or scattered trees occurring on all of the fire-marked areas. The eastern sections contain large quantities of good mill timber, red fir in standard dimensions being the prevailing species.

The western and central sections are difficult of access; the eastern can be logged from the Rogue River bottoms on the east.

Forested and other areas in T. 31 S., R. 2 E., Oregon.

	Acres.
Forested area	23,040
Badly burned area	8,500
Logged area	None.

Total stand of timber in T. 31 S., R. 2 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	9.8	18,000,000	23,467,200
Sugar pine	4.9	9,000,000	9,850,000
Red fir	65.5	120,000,000	205,338,000
White fir	....	....	6,000,000
Noble fir	5.4	10,000,000	14,000,000
Incense cedar	.6	1,000,000	1,684,000
Alpine hemlock	13.7	25,000,000	33,000,000
Total	....	183,000,000	293,339,200

Composition of forest in T. 31 S., R. 2 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	10
Sugar pine	2
Red fir	65
White fir	3
Noble fir	5
Alpine hemlock	15
Incense cedar	.01

TOWNSHIP 31 SOUTH, RANGE 3 EAST.

The western sections of this township consist of low, rocky terminations of spurs radiating from the Umpqua-Rogue River divide. The central sections comprise a strip of terraced bottom land 2 miles wide, stretching through the township from north to south, deeply covered with pumice débris, and constituting the valley, in part, of the North Fork of Rogue River. The eastern areas consist of a steep, rocky escarpment falling away to the west from the summit of Huckleberry Mountain, a volcanic plateau-like tract in some of its portions and connected with the main range of the Cascades in its southeastern corner.

The run-off from the township is small and is carried by the North Fork of Rogue River. The bed of the stream lies between low banks 4 or 5 yards in height. Its current is rapid, but is interrupted in several localities by dikes of lava, through which the stream has cut narrow rocky channels.

There are small tracts of grazing and hay lands bordering the river, 500 or 600 acres in all; otherwise there are no clear lands in the township. The Rogue River bottoms, now heavily forested, would probably become agricultural in character were the timber cleared off. This would give 4,000 or 4,500 acres of such land to the township.

The forest is made up of all the types in the region. The yellow-pine type occurs in the western portions chiefly, and in detached patches mixed with red-fir type in the Rogue River bottoms, where it exists as reforestations after fires, and in the natural course of events will be supplanted by red fir. The chief stands of the red-fir type occur on the bottom lands. It is a massive forest, composed almost wholly of veterans and standards. Much of it is of large dimensions. The red fir averages 2 to 4 feet in diameter, with clear trunks 50 to 100 feet in height; the sugar pine is about the same size for standards, while veterans are often found that are 7 to 8 feet in diameter, with clear trunks 40 to 60 feet in length. Unfortunately there is not a great deal of this sort of forest, which only occurs on the lowest terraces of the bottom lands. The tract can be logged with the greatest facility, and appears to be held wholly by private owners who long since acquired title to it. The alpine-hemlock type occurs on the slopes leading up to the summit of Huckleberry Mountain. It is of poor quality and practically inaccessible for logging operations.

With the exception of red-fir stands on bottom lands the forest has been marked by fire throughout the township. The slopes of Huckleberry Mountain have especially suffered severely.

Reforestation is scanty everywhere; it is practically lacking on Huckleberry Mountain, where heavy brush growths flourish on all the fire-swept areas.

There are no mineral-bearing areas in the township.

Forested and other areas in T. 31 S., R. 3 E., Oregon.

	Acres.
Forested area	10,880
Nonforested area (glades and meadows, 4,000; burned, 8,160)	12,160
Badly burned area	15,000
Logged area	None.

Total stand of timber in T. 31 S., R. 3 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	3.3	5,000,000	8,000,000
Sugar pine	5.2	8,000,000	9,000,000
White pine			1,000,000
Red fir	88.8	135,000,000	150,000,000
White fir	2.6	4,000,000	12,000,000
Noble fir			2,000,000
Western hemlock			480,000
Alpine hemlock			1,200,000
Total		152,000,000	183,680,000

Composition of forest in T. 31 S., R. 3 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	6
Sugar pine	2
White pine	.1
Lodgepole pine	.5
Red fir	75
White fir	12
Noble fir	3
Alpine fir	.25
Western hemlock	.01
Alpine hemlock	.5

Township 31 South, Range 4 East.

Most of this township consists of tracts comprised within the lines of Huckleberry Mountain, a volcanic mass rising to a height of 6,000 feet, and connected with the main range of the Cascades by a narrow ridge in the southeastern angle of the township. The summit of Huckleberry forms a sort of plateau broken by a few minor depressions and low combs. On its southern side the mountain slopes gradually into Red Blanket Canyon. On the north it presents a bold and steep front to the Rogue River Valley, while on the east there is a steep descent to the narrow bottom of Union Creek. The region is covered with a blanket of fine pumice, which is not very thick on Huckleberry Mountain, but is of unknown depth in the northern portions of the township at the base of the mountain. The drainage discharged from the township is large in volume and flows out by way of Union Creek into the North Fork of Rogue River.

The township contains no agricultural lands. The grazing areas consist of fire glades on the top of the mountain. There is a thin and sparse growth of grass and sedge everywhere on the burned tracts. In the center of the township the glades originated centuries ago and carry a close, thick sward of grass.

No mineral-bearing lands occur in the township.

Fire has marked all of the forest. Almost one-half of the entire area in the township has had all its forest swept off clean. Some of the burns are very old; many are of quite recent origin. In the latter there is a vast accumulation of litter ready for fresh conflagrations. Reforestation is scanty, in most places entirely absent. The burned tracts are covered with thin growths of grass or overrun with blackberry brambles and huckleberry brush. The burns constitute the famous huckleberry patch of the Klamath Indians. When berries are ripe, Indians and white men, women and children, from within a radius of 100 miles congregate here to pick berries. As reforestations would inevitably spoil the berry patch the incentive to fire setting is great with these people.

Most of the forest is composed of stands belonging to the alpine-hemlock type. The heaviest growth occurs adjacent to and in the canyon of Union Creek. Anterior to the fires set by the white man the larger portion of the mountain contained many heavy stands of noble fir and white pine. The timber that is untouched by fire is of fair quality, but most of it is inaccessible to loggers. In Union Creek Canyon occurs the largest and purest growth of western hemlock to be found in the southern part of the Cascade Range Forest Reserve. The trees are small, however, averaging 18 to 22 inches in diameter at the base, with clear trunks 20 to 30 feet in length. Yellow pine, red fir, and incense cedar occur in small quantities in the northern portion of the township at the base of the mountain.

Forested and other areas in T. 31 S., R. 4 E., Oregon.

	Acres.
Forested area	14,720
Nonforested area (burned)	8,320
Burned-out area	8,320
Logged area	None.

Total stand of timber in T. 31 S., R. 4 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			1,000,000
Sugar pine			1,000,000
White pine	6.6	5,000,000	6,000,000
Red fir			4,200,000
Noble fir	79	60,000,000	98,000,000
Incense cedar			600,000
Western hemlock	4	3,000,000	8,000,000
Alpine hemlock	10.4	8,000,000	13,400,000
Total		76,000,000	132,200,000

Composition of forest in T. 31 S., R. 4 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	.01
Sugar pine	.01
White pine	3
Lodgepole pine	15
Incense cedar	.001
Red fir	.5
White fir	2
Noble fir	70
Western hemlock	5
Alpine hemlock	4

Township 31 South, Range 5 East.

With the exception of its southeast corner this township is situated on the western slope of the main range of the Cascades. Two-thirds of the area included within its limits consist of tracts nearly level or with very gentle slopes toward the east. In the eastern sections rocky combs and low volcanic cones break up the level surface, while near the southern boundary, Union Peak, surrounded by rough lava masses, rises to a height of 7,881 feet above sea level. The northern portions of the township consist of a low range of lava hills with an east-west direction. Pumice débris, mostly fine, but occasionally in bowlder-like masses, covers all of the township excepting the summits of the extinct volcanoes and a number of rocky escarpment too steep to hold the pumice in place.

The visible run-off originating in the township is small and flows into Rogue River by way of Castle Creek. The channel of this stream is sunk in a canyon 300 to 350 feet in depth excavated in the loose pumice.

There are no agricultural or mineral lands in the township. The grazing area embraces the entire tract, exclusive of Union Peak, and consists wholly of areas on which the forest has been burned, there being no natural meadows in the region. The grass growth is sparse and scattered. In former years sheep were pastured everywhere in the township, but during the last two years none have been there.

Exclusive of a few stands of red fir and yellow pine in the northwest corner of the township, the forest is of the alpine-hemlock type. Eighty per cent of the timber has been burned since the white man's occupancy, and the burned-over tracts, which originally carried stands of noble fir and alpine hemlock, have reforested with thin and scattered stands of lodgepole pine or are without forest cover. Most of the present forest consists of this species. Fires within recent years have destroyed considerable quantities of these reforestations. Owing to the altitude of the township, 6,000 feet in the mean, brush growths do not flourish. Hence fires are followed by a thin sward of coarse grass and sedge, which after a lapse of some years becomes covered with stands of lodgepole pine, the forerunner of the alpine-hemlock type proper, of noble fir and alpine hemlock. Sixty per cent of the area of the township is covered with this transition type of forest. The glades due to recent fires are not reforesting to any great extent, but bear preliminary grass growth or are devoid of vegetation, save for a few scattered weeds and high altitude plants.

The mill timber is of poor quality and is widely scattered, mostly in localities where barren, rocky ground prevented the spread of fires. To the south and east of Union Peak are a few heavy stands of alpine hemlock and noble fir. Most of the township is accessible for logging operations by way of the present Fort Klamath-Rogue River wagon road.

Forested and other areas in T. 31 S., R. 5 E., Oregon.

	Acres.
Forested area	20, 480
Nonforested area (bare rocks)	2, 560
Badly burned area	4, 000
Logged area	None.

Total stand of timber in T. 31 S., R. 5 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			200, 000
Red fir			680, 000
Noble fir	50	10, 000, 000	20, 000, 000
Alpine hemlock	50	10, 000, 000	36, 000, 000
Total		20, 000, 000	56, 880, 000

Composition of the forest in T. 31 S., R. 5 E., Oregon, including trees of all species with diameters of 4 inches and upward.

	Per cent.
Yellow pine	Scattered trees in Union Creek Canyon.
Sugar pine	Scattered trees in Union Creek Canyon.
White pine	Scattered trees in Union Creek Canyon.
Lodgepole pine	40
Red fir	Scattered trees in Union Creek Canyon.
White fir	Scattered trees in Union Creek Canyon.
Noble fir	3
Alpine fir	Scattered.
Alpine hemlock	56

Township 31 South, Range 6 East.

This township is situated mostly on the eastern slopes of the Cascades, a hundred acres in the northwest corner extending over on the western slope.

Almost the entire township consists of high, rocky, lava ridges varying in elevation from 6,000 to 7,000 feet, with occasional flats between them and on their summits. Most of the region is pumice covered.

A large volume of water flows out of the township. It is carried by Anna and Sun creeks, which head in large springs near Crater Lake. The streams lie in deep canyons, the one containing Anna Creek being noteworthy on account of its gorge-like character.

The township contains no agricultural lands. There are small tracts of grazing land consisting of fire glades now in process of reforestation. Sheep were pastured in the western sections of the township in former years. There have been none in the last two or three years.

The forest consists of stands of alpine-hemlock type. It is fire marked throughout. Fifty per cent of the timber has been burned by fires originating since the coming of the white man, but long before his advent the region was periodically burned over. Most of the forest consists of reforestations of lodgepole pine, or of small-growth alpine hemlock, white pine, and noble fir, which are gradually supplanting the lodgepole pine. Some of these reforestations are in a fair state of preservation; others have been badly burned in recent years. Much of the area here termed forested contains only scattered trees and might, perhaps, be more appropriately classed as wooded. This is the case with all the areas in the northern sections adjoining Crater Lake, which naturally are barren and rocky and carry only small amounts of arborescent vegetation in thin, widely scattered stands.

The mill timber is of poor quality throughout. Most of it occurs on rough lava ridges situated between the canyons of Anna and Sun creeks in the central portions of the township. The crest of the Cascades, a narrow comb of lava in the western areas, carries a few heavy stands of alpine hemlock and noble fir. The region is inaccessible for logging operations.

Forested and other areas in T. 31 S., R. 6 E., Oregon.

	Acres.
Forested area	21, 440
Nonforested area (bare rocks)	1, 600
Badly burned area	4, 000
Logged area	None.

Total stand of timber in T. 31 S., R. 6 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
White pine			5,000,000
White fir			5,000,000
Noble fir	40	10,000,000	15,000,000
Alpine hemlock	60	15,000,000	25,000,000
Engelmann spruce			520,000
Total		25,000,000	50,520,000

Composition of forest in T. 31 S., R. 6 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	Occasional trees.
Sugar pine	Occasional trees.
White pine	0.5
White-bark pine	Occasional trees.
Lodgepole pine	30
White fir	3
Noble fir	10
Alpine fir	Occasional trees.
Alpine hemlock	56
Engelmann spruce	.001

TOWNSHIP 31 SOUTH, RANGE 6½ EAST.

This township is situated on the eastern slope of the main range of the Cascades, and comprises a mass of rocky spurs and ancient lava flows radiating from Mount Scott and the volcanic vents in the region of Crater Lake as their focus.

The forest on the higher slopes is subalpine in character. Fires have ravaged it in all directions. The burned tracts are either slowly reforesting with lodgepole pine and alpine hemlock or are covered with dense brush growths.

Mill timber is confined to the lower slopes of the ridges radiating from Mount Scott and to the middle elevations on the areas southeast of Crater Lake. The subalpine varieties are of poor quality; the yellow pine on the lowest slopes is fair in character and not especially difficult of access.

Forested and other areas in T. 31 S., R. 6½ E., Oregon.

	Acres.
Forested area	21,040
Nonforested area (bare rocks and glades)	2,000
Badly burned area	6,000
Logged area	None.

Total stand of timber in T. 31 S., R. 6½ E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	77.0	50,000,000	65,000,000
White fir			1,000,000
Noble fir	7.7	5,000,000	5,000,000
Alpine hemlock	15.3	10,000,000	27,920,000
Total		65,000,000	98,920,000

Composition of forest in T. 31 S., R. 6½ E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	55
Sugar pine White pine White-bark pine	1
Lodgepole pine	20
White fir	1
Noble fir	2
Alpine hemlock	20
Engelmann spruce	.1

TOWNSHIP 31 SOUTH, RANGE 7 EAST.

This township consists of level, pumice-covered areas along the eastern base of the Cascades.

The forest in the central and eastern portions is chiefly a lodgepole growth, reforestations after fires which burned and destroyed the timber thirty or forty years ago. Before these fires the forest was lodgepole also, made so by fires during the exclusive Indian occupancy.

The mill timber is yellow pine, and occurs in the western and southwestern areas, with small stands of it scattered among the lodgepole-pine growth. It is of medium quality, being knotty and fire seared.

Forested and other areas in T. 31 S., R. 7 E., Oregon.

	Acres.
Forested area	20,000
Nonforested area (rocks and glades)	3,040
Logged area	None.

Total stand of timber in T. 31 S., R. 7 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	40,000,000	71,500,000
White fir			500,000
Total		40,000,000	72,000,000

Composition of forest in T. 31 S., R. 7 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	24
Lodgepole pine	75
White fir Incense cedar	1

TOWNSHIP 31 SOUTH, RANGE 8 EAST.

This township is situated east of the Cascade Range. The northwestern and the southeastern areas consist of low, pumice-covered levels but slightly elevated above Klamath Marsh which carry a forest of lodgepole pine, which marks the lines of comparatively recent recessions of the marsh. The balance of the lands in the township comprise marsh and tule lands, permanently or intermittingly covered with water derived from the Williamson River and from local drainage. The forest is composed entirely of lodgepole pine, with no mill timber at all.

Forested and other areas in T. 31 S., R. 8 E., Oregon.

	Acres.
Forested area	5,640
Nonforested area (Klamath Marsh)	17,400

TOWNSHIP 31 SOUTH, RANGE 9 EAST.

This township is situated east of the Cascades. It comprises in its western areas chiefly permanently water-covered tracts of Klamath Marsh; in its eastern portions low, pumice-covered lava ridges and slopes, which are intersected by or inclose small grassy glades.

The hills and higher levels carry yellow pine, while lodgepole pine fringes the marshy areas and the small glades. Fires have run through all the forest stands in the township, badly searing much of the yellow pine.

The mill timber is easy of access, is of medium quality, but contains a large percentage of dimensions below standards, 45 per cent running below 22 inches basal diameter.

Forested and other areas in T. 31 S., R. 9 E., Oregon.

	Acres.
Forested area	14,740
Nonforested area (marsh and meadow)	8,300
Logged area	None.

Total stand of timber in T. 31 S., R. 9 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	35,000,000	76,160,000

Composition of forest in T. 31 S., R. 9 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	80
Lodgepole pine	19
White fir	1

TOWNSHIP 31 SOUTH, RANGE 10 EAST.

This township, situated east of the Cascade Range, consists of low, rolling hills, volcanic in their origin, covered with a fine, light, ashy-gray pumice detritus and furrowed by shallow gullies which occasionally widen into small grassy glades or flats covered with lodgepole pine.

Most of the timber is fire marked, but the damage has been light. Fires have not run much in later years and the young growth of yellow pine is therefore abundant.

The mill timber is mostly composed of standards and veterans with exceptionally long, clear trunks. The stand of timber in the township is as a whole a most valuable one. It is readily accessible from the valley of the Williamson River.

Forested and other areas in T. 31 S., R. 10 E., Oregon.

	Acres.
Forested area	23,040
Logged area	None.

Total stand of timber in T. 31 S., R. 10 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet. B. M.*
Yellow pine	100	200,000,000	220,800,000

Composition of forest in T. 31 S., R. 10 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	95
Lodgepole pine	4
White fir	1

TOWNSHIP 31 SOUTH, RANGE 11 EAST.

This township is situated east of the Cascade Range. The lands in this township consist in the eastern areas of lava slopes and ridges radiating from the Yamsay Range; in the western areas partly of dry meadow lands bordering the Williamson River, and in part of low pumice-covered lava slopes bordering the west bank of the Williamson River.

The forest is fire marked throughout; the damage has been light. Lodgepole-pine stands fringe the meadow lands along the Williamson, yellow-pine timber covers the slopes.

The mill timber is of good quality, largely composed of standards, and is readily accessible from the Williamson River bottoms.

Forested and other areas in T. 31 S., R. 11 E., Oregon.

	Acres.
Forested area	19,140
Nonforested area (meadows and glades)	3,900
Logged area	None.

Total stand of timber in T. 31 S., R. 11 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	140,000,000	200,000,000
White fir			2,900,000
Total		140,000,000	202,900,000

Composition of forest in T. 31 S., R. 11 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	95
Lodgepole pine	4
White fir	1

TOWNSHIP 31 SOUTH, RANGE 12 EAST.

This township is situated on the eastern slopes of the Yamsay Range, a pumice-covered lava region. The area was not examined personally, but was estimated from information.

Forested and other areas in T. 31 S., R. 12 E., Oregon.

	Acres.
Forested area	15,040
Nonforested area	8,000
Logged area	None.

Total stand of timber in T. 31 S., R. 12 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	17,000,000	25,000,000

Composition of forest in T. 31 S., R. 12 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	40
Lodgepole pine	60

TOWNSHIP 31 SOUTH, RANGE 13 EAST.

This township consists of low hills bordering Sycan Marsh on the west. It was not examined personally, but was estimated from information.

Forested and other areas in T. 31 S., R. 13 E., Oregon.

	Acres.
Forested area	11,040
Nonforested area	12,000
Logged area	None.

Total stand of timber in T. 31 S., R. 13 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	8,000,000	12,000,000

Composition of forest in T. 31 S., R. 13 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	20
Lodgepole pine	80

TOWNSHIP 31 SOUTH, RANGE 14 EAST.

The lands in this township consist chiefly of areas adjoining Sycan Marsh. They were not examined personally, but were estimated from information.

Forested and other areas in T. 31 S., R. 14 E., Oregon.

	Acres.
Forested area	11,040
Nonforested area	12,000
Logged area	None.

Total stand of timber in T. 31 S., R. 14 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	24,000,000	48,000,000

Composition of forest in T. 31 S., R. 14 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	10
Lodgepole pine	90

TOWNSHIP 32 SOUTH, RANGE 2 WEST.

This township is situated on both slopes of the Umpqua-Rogue River divide, which strikes through the township from west to east. It is a very rocky and broken region and difficult of access for lumbering operations. It was examined in part personally and the balance estimated from information.

Forested and other areas in T. 32 S., R. 2 W., Oregon.

	Acres.
Forested area	22,440
Nonforested area (naturally nonforested)	600
Badly burned area	3,500
Logged area	None.

Total stand of timber in T. 32 S., R. 2 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	7.4	10,000,000	15,000,000
Sugar pine	3.7	5,000,000	6,000,000
Red fir	86.3	116,500,000	175,000,000
White fir	2.2	3,000,000	12,000,000
Incense cedar	.4	500,000	1,000,000
Total		135,000,000	209,000,000

TOWNSHIP 32 SOUTH, RANGE 1 WEST.

This township consists of a broken and rugged region sloping north and south from the Umpqua-Rogue River divide, which traverses the township in an east-west direction. It is difficult of access for lumbering operations.

The forest is fire-marked throughout. Result of fires is brush growths on the southern slopes; reforestations of red fir on the summits and north slopes of the ridges.

The mill timber is of inferior quality, being largely composed of red fir, tall in growth, but of small diameters. Most of the sugar pine is made up of standards and veterans, badly burned on the lower third of the trunk.

Forested and other areas in T. 32 S., R. 1 W., Oregon.

	Acres.
Forested area	21,840
Nonforested area (burned)	1,200
Badly burned area	5,000
Logged area	None.

Total stand of timber in T. 32 S., R. 1 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	13.9	20,000,000	30,000,000
Sugar pine	4.9	7,000,000	8,000,000
Red fir	75	108,000,000	195,000,000
White fir	5.5	8,000,000	13,000,000
Incense cedar	.7	1,000,000	2,000,000
Total		144,000,000	248,000,000

Composition of forest in T. 32 S., R. 1 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	20
Sugar pine	.01
Red fir	70
White fir	8
Incense cedar	.001
Oaks, etc	1.9

TOWNSHIP 32 SOUTH, RANGE 1 EAST.

This township is situated on the southern slopes of the Umpqua-Rogue River divide, and chiefly forms the upper drainage basin of Elk Creek. It is a very broken region with steep slopes and narrow canyons between the ridges.

The forest is heavy along the upper slopes where fires have spared it, but is of thin and scattering growth on the lower declivities fronting on the Rogue River Valley. The forest is fire-marked throughout and exhibits large areas covered with brush and with but scattered trees as the result.

The mill timber is of inferior quality, being badly fire-seared as regards the red fir, which is generally of small dimensions.

Forested and other areas in T. 32 S., R. 1 E., Oregon.

	Acres.
Forested area	23,040
Badly burned area	8,000
Logged area (culled and cut over for mining purposes)	200

Total stand of timber in T. 32 S., R. 1 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	16.6	30,000,000	48,000,000
Sugar pine	.5	800,000	800,000
Red fir	81.6	147,000,000	190,000,000
White fir	1.1	2,000,000	8,000,000
Incense cedar	.2	200,000	440,000
Total		180,000,000	247,240,000

Composition of forest in T. 32 S., R. 1 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	22
Sugar pine	.2
Red fir	70
White fir	5
Oaks, etc	2.8

TOWNSHIP 32 SOUTH, RANGE 2 EAST.

This township comprises a mass of high, often rocky, spurs projecting southward from the Umpqua-Rogue River divide.

Fires have run throughout the township, causing large deforested areas now covered with brush growths. The slopes fronting on the Rogue River Valley are mostly rocky, with sparse forest stands of yellow pine and small red fir.

The mill timber is generally of poor quality, and much of it is inaccessible.

Forested and other areas in T. 32 S., R. 2 E., Oregon.

	Acres.
Forested area	18,540
Nonforested area (burned, 2,000; agricultural, etc., 2,500)	4,500
Badly burned area	7,500
Logged area (culled over)	2,000

Total stand of timber in T. 32 S., R. 2 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	58.8	40,000,000	54,000,000
Sugar pine	7.3	5,000,000	6,000,000
Red fir	29.4	20,000,000	110,000,000
White fir	3.7	2,500,000	10,000,000
Incense cedar	.7	500,000	1,120,000
Total		68,000,000	181,120,000

Composition of forest in T. 32 S., R. 2 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	30
Sugar pine	1
Red fir	60
White fir	6
Incense cedar	.3
Oaks, etc	2.7

TOWNSHIP 32 SOUTH, RANGE 3 EAST.

This township consists of level bottom lands in the Rogue River Valley, with portions of the Mill Creek and Red Blanket bottoms and benches.

The forest is of massive proportions, but its uniformity is broken by numerous patches of young red-fir, yellow-pine, and lodgepole-pine stands, which are reforestations after ancient fires—that is, of fires which burned within the last eighty or one hundred years. Settlements along the Mill Creek bottoms have made inroads in the forest. Modern fires have burned chiefly along Red Blanket Creek.

The mill timber is excellent and easy of access. Much of the red fir and sugar pine run from 5 to 7 feet basal diameters, with clear trunks 70 feet in length.

Reproduction is good; soil is chiefly a pumice sand.

Forested and other areas in T. 32 S., R. 3 E., Oregon.

	Acres.
Forested area	17,940
Nonforested area (burned 4,000; meadows and glades, 1,100)	5,100
Badly burned area	3,000
Logged area (culled over)	2,500

Total stand of timber in T. 32 S., R. 3 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	5.7	20,000,000	45,000,000
Sugar pine	28.5	100,000,000	100,000,000
White pine	1.4	5,000,000	6,000,000
Red fir	63	220,000,000	286,000,000
White fir	1.4	5,000,000	12,240,000
Western hemlock			3,000,000
Total		350,000,000	452,240,000

Composition of forest in T. 32 S., R. 3 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	9
Sugar pine	22
White pine	1
Lodgepole pine	1
Western hemlock	.5
Red fir	60
White fir	6
Noble fir	Scattered trees.
Oaks, etc.	.5

Township 32 North, Range 4 East.

The position of this township is well over on the western declivities of the Cascades. It comprises rocky and mountainous slopes draining partly into Red Blanket Canyon and partly into the canyon of the Middle Fork of Rogue River. The southern areas are especially rocky and broken, a point named Bessie Rock being the nucleus for a system of deeply sculptured ridges and canyons. In the extreme southern part of the township, where the ridges that center in Bessie Rock break off to the canyon of the Middle Fork, they present a front 2,800 feet in height. The soil everywhere is thin and mostly composed of pumice. Much of it appears to have been washed away as a result of forest fires.

The drainage channels consist of the middle portions of Red Blanket Creek and a 4 or 5 mile section of the Middle Fork of Rogue River. Red Blanket is a small stream and carries a moderate volume of water.

The township contains no grazing or agricultural lands and no known mineral-bearing areas.

The forest belongs wholly to the alpine-hemlock type. Formerly many of the stands of noble fir and alpine hemlock must have been of fine proportions. Within the last forty years fires have laid low most of the timber and damaged that which still stands on root. The fires have been hot and have covered a large area. On the slopes facing the Middle Fork Canyon one may look up and down for miles and not see many trees. On most of the burned-over area there is practically no reforestation. Brush has taken the place of the forest and apparently is in permanent possession.

Most of the mill timber is of small dimensions and is damaged by fire. Much of it consists of noble fir. On the south side of Red Blanket there is now and then a stand where this species averages 30 inches in diameter at the base, with clear trunks 30 to 40 feet in length.

With the exception of limited tracts in the extreme western sections the areas of the township are inaccessible for logging operations.

Forested and other areas in T. 32 S., R. 4 E., Oregon.

	Acres.
Forested area	10,040
Nonforested area (burned)	13,000
Badly burned area	13,000
Logged area	None.

Total stand of timber in T. 32 S., R. 4 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
White pine	5.8	3,000,000	5,000,000
Noble fir	88.3	45,000,000	90,000,000
Western hemlock	2.	1,000,000	3,000,000
Alpine hemlock	3.9	2,000,000	7,960,000
Total		51,000,000	105,960,000

Composition of forest in T. 32 S., R. 4 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
White pine	2
Red fir	Inconsiderable.
Alpine fir	Inconsiderable.
Noble fir	88
Western hemlock	3
Alpine hemlock	5

Township 32 South, Range 5 East.

This township occupies areas on the summit and western slopes of the Cascades with the exception of a few hundred acres in the northeast and southeast angles, which overlap on the eastern side of the range. The summit of the Cascades strikes through the township from north to south along its east line. In the northern and in the southern portions the summit is a broad, pumice-covered level in some places a mile in width with only a few low combs interrupting the flat surface. In the central portions many cross ridges and isolated rocky buttes break up the summit level of the range into an irregular, comparatively narrow crest. Most of the township consists of a basin-like tract hemmed in on the north, east, and south by terraced lava flows which had their origin partly in Union Peak, a volcanic center in the next township north, partly in various vents along the main summit in the central and southwestern areas of the township.

The drainage from the township is small in volume. Most of it is carried by Red Blanket Creek, which has its rise in the eastern sections. An insignificant quantity finds its way into the Middle Fork of

Rogue River. Evidently the larger portion of the annual precipitation which falls on the areas of the township sinks in the loose pumice and fissured lava and is lost to view.

No agricultural lands exist in the township. The grazing areas contain in the aggregate 1,500 acres and consist exclusively of fire glades which are reforesting more or less rapidly. Cattle and sheep were pastured in the township in former years. None have been there in recent years.

The forest is of the alpine-hemlock type throughout. It occurs in stands of many different ages, each group or aggregation occupying small areas surrounded and separated by extensive tracts of burned-over ground. Fires of modern times have destroyed 60 per cent of the forest. Not all of the fire glades and burned-over tracts are due to the white man. Very many date back to the Indian occupancy. The township appears to have been peculiarly exposed to forest fires from as far back as it is possible to trace the history of the present forest. Reforestations consist of lodgepole pine and alpine hemlock, the former species predominating. Owing to the altitude at which the township is situated, 6,000 feet in the mean, brush growths after fires are lacking. If a return to forest cover does not take place, then the ground either remains bare of vegetation or a thin interrupted sward of sedge and grass comes in.

Most of the mill timber is of inferior quality, besides being composed of species of no value from the lumberman's point of view. The altitude of the region averages too great for extensive stands of large timber in this latitude, but occasional stands of alpine hemlock, 200 to 300 years old, exhibit fine proportions. At this elevation the species usually grows in close groups, composed of 10 or 20 individuals collected together on what appears to be a common root. Such close growth develops clear trunks, although not commonly of large diameters. Stands of this character sometimes run as high as 25,000 feet B. M. per acre. Their extent is, however, quite limited.

The areas of the township are inaccessible for logging operations, and no mineral-bearing ground is there known to occur.

Forested and other areas in T. 32 S., R. 5 E., Oregon.

	Acres.
Forested area	11,440
Badly burned area (nonforested, deforested by fires)	11,600
Logged area	None.

Total stand of timber in T. 32 S., R. 5 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
White pine	3.5	1,300,000	1,900,000
Noble fir	26.8	10,000,000	14,000,000
Western hemlock			600,000
Alpine hemlock	69.7	26,000,000	52,000,000
Engelmann spruce			460,000
Total		37,300,000	68,960,000

Composition of forest in T. 32 S., R. 5 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
White pine	1
Noble fir	12
Alpine fir	2
Lodgepole pine	15
Alpine hemlock	68
Other species	2

Township 32 South, Range 6 East.

The position of this township is on the eastern slope of the Cascades. The western portion consists of a strip of the summit of the range. It is pumice covered throughout, level in some places, while in others it is made up of lava combs, with one conspicuous truncate volcanic cone locally known as "Goose Nest."

The central portions consist of many lava terraces and low ridges, the whole constituting a long gradual slope to the foot of the range. The eastern sections comprise flat, level tracts but slightly elevated above the marshy tracts at the north end of Upper Klamath Lake, which barely reach beyond the lines of the township in the southeast angle.

With the exception of a few insignificant springs, the township possesses no visible stream within its boundaries. The northeastern portions are intersected by Anna Creek, a stream heading in the township adjoining on the north. Where the stream enters the township its bed is sunk in a canyon 350 to 400 feet in depth, with nearly perpendicular walls, and having a width of about 100 yards at its brink. After emerging from the lava flows and terraces in which the canyon is sunk, the stream flows the balance of the way through the township in a channel with banks 10 to 15 feet in height. Its water is used by settlers in the adjoining township on the east for purposes of irrigation.

The township has a small amount of land which, when cleared and irrigated, can be used for grazing and agricultural purposes. The total amount is in the neighborhood of 1,000 acres. At present the tract carries an open and scattered growth of yellow and lodgepole pine. There is a thin sward of grass and sedge among the trees, and the land is at present utilized for a cattle range.

No mineral-bearing areas are known to occur.

The forest consists of stands of yellow-pine and alpine-hemlock types. It is fire marked throughout. Most of the old and standard growth of alpine-hemlock type has long since been burned, and reforestations, made up of lodgepole pine, white pine, and alpine hemlock, of small size and in dense, thick stands, have taken the place of the former forest. The stands of yellow-pine type have been grievously thinned by the fires, and dense masses of underbrush, composed almost exclusively of the vellum-leaved ceanothus, have occupied the place of the burned forest.

The only mill timber in the township of any commercial value at the present time is the yellow pine. It is only of medium quality, being defective from fire sears and unusually knotty in the trunk. It is easy of access, as it grows only on the lowest levels. The white fir is generally too knotty and short of trunk to be of any value; besides a large proportion, fully 50 per cent, is defective, owing to rot induced by fire. The logging operations have been confined to culling the sugar pine for the use of settlers in adjoining townships to the east.

The areal and timber estimates for the township are as follows:

Forested and other areas in T. 32 S., R. 6 E., Oregon.

	Acres.
Forested area	20,440
Nonforested area (meadows, glades, and agricultural)	2,600
Badly burned area	5,000
Logged area (culled over)	1,000

Total stand of timber in T. 32 S., R. 6 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	76.3	42,000,000	65,000,000
White pine			3,000,000
White fir	18.2	10,000,000	30,000,000
Noble fir			1,480,000
Alpine hemlock	5.4	3,000,000	10,000,000
Total		55,000,000	109,480,000

Composition of forest in T. 32 S., R. 6 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	24
Sugar pine	Scattered trees.
White pine	.2
Lodgepole pine	30
Engelmann spruce	Scattered trees.
Cottonwoods, etc	1
Red fir	Scattered trees.
Noble fir	1
White fir	6
Alpine fir	.1
Alpine hemlock	37

TOWNSHIP 32 SOUTH, RANGE 7½ EAST.

This township is situated east of the Cascade main range. It consists of low pumice-covered lava slopes and ridges in the western areas and of marshy tracts in the central portions, which rise into low lava plateaus or ridges in the eastern sections.

Fires have run everywhere throughout the forest stands in the township, producing lodgepole-pine and brush growths.

The mill timber occurs as a fairly solid body in the eastern sections, and as scattered aggregations intermixed with much lodgepole pine elsewhere. It is of medium quality and easy of access.

Forested and other areas in T. 32 S., R. 7½ E., Oregon.

	Acres.
Forested area	16,640
Nonforested area (marsh, meadow, and agricultural)	6,400
Badly burned area	7,500
Logged area	800

Total stand of timber in T. 32 S., R. 7½ E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	83.3	50,000,000	65,000,000
Sugar pine	8.3	5,000,000	5,000,000
White fir	8.3	5,000,000	15,000,000
Incense cedar			300,000
Total		60,000,000	85,300,000

Composition of forest in T. 32 S., R. 7½ E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent
Yellow pine	70
Sugar pine	1
White pine	Scattered trees along Anna Creek.
Lodgepole pine	15
Red fir	Scattered trees along Anna Creek.
White fir	13.5
Incense cedar Cottonwoods	.5

TOWNSHIP 32 SOUTH, RANGE 7 EAST.

This township is situated east of the Cascade Range, and consists of a rolling plateau, pumice covered, furrowed by shallow ravines, and ridged here and there by low spurs extending from the Cascades.

The forest is fire marked throughout. Result of the fires is suppression of undergrowth and seedling and sapling growth, with formation of lodgepole-pine stands along the slopes and in the bottoms of the ravines.

The mill timber is chiefly yellow pine. Except for the fire marks the pine is fair in appearance, but the timber when sawed is found to be knotty with twisted grain. This is a common defect inherent in all yellow pine east of the Cascades in this region, and is due to the very open growth caused by the frequently repeated fires of the past and present times.

Forested and other areas in T. 32 S., R. 7 E., Oregon.

	Acres.
Forested area	20,540
Nonforested area (meadows and glades, 1,000; burned, 1,000)	2,000
Badly burned area	1,000
Logged area	None.

Total stand of timber in T. 32 S., R. 7 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	94.6	140,000,000	160,480,000
Sugar pine	5.4	8,000,000	9,440,000
White fir			18,880,000
Total		148,000,000	188,800,000

Composition of forest in T. 32 S., R. 7 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	64
Sugar pine	5
Lodgepole pine	.5
White fir	30
Deciduous species	.5

TOWNSHIP 32 SOUTH, RANGE 8 EAST.

This township is situated east of the Cascade Range. It comprises marsh lands, nonforested, wet and swampy areas, and broad flats in the northern and central areas; volcanic buttes and slopes covered with pumice in the southern sections.

The low lands carry stands of almost pure lodgepole-pine growths; the areas at higher levels carry stands of yellow pine. The yellow-pine forest is fire marked throughout with resultant suppression of underbrush and young forest growth, and extensive fire searing of the larger trees. The lodgepole pine is here not the result of fires, but is the primary coniferous growth on land too wet to bear any other.

The mill timber is of poor quality and occurs on the hills and slopes in the southern sections. It is easy of access from Klamath Marsh.

Forested and other areas in T. 32 S., R. 8 E., Oregon.

	Acres.
Forested area	18,240
Nonforested area (marsh and meadow)	4,800
Logged area	None.

Total stand of timber in T. 32 S., R. 8 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	22,000,000	34,560,000

Compositon of forest in T. 32 S., R. 8 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	15
Lodgepole pine	85

TOWNSHIP 32 SOUTH, RANGE 9 EAST.

This township is situated east of the Cascades and comprises in the western and central areas wet or swampy lands, in some places permanently covered with water, in others intermittently wet and dry. It carries stands of small-growth lodgepole pine or, where too wet, produces marsh grass, sedge, rush or tule.

The eastern areas consist of low, pumice-covered hills and slopes, volcanic in their origin, carrying moderately heavy stands of yellow pine of medium quality, short bodied and with diameters, for the mill timber, of from 20 to 30 inches; 25 per cent of the stand is worthless in the lower 6 feet of trunk owing to fire scars.

The mill timber is easy of access.

Forested and other areas in T. 32 S., R. 9 E., Oregon.

	Acres
Forested area	14,000
Nonforested area (marsh and meadow)	9,040
Logged area	None.

Total stand of timber in T. 32 S., R. 9 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	50,000,000	98,000,000

Composition of forest in T. 32 S., R. 9 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	40
Lodgepole pine	60

TOWNSHIP 32 SOUTH, RANGE 10 EAST.

This township is situated east of the Cascade Range, and consists of low, pumice-covered hills of volcanic origin, lying between Klamath Marsh and Williamson River.

The forest is fire marked throughout. The eastern areas contain areas of grassy swales, branching out from the Williamson River bottoms, thinly covered with scattered stands of lodgepole pine. The higher levels carry good stands of a fair quality of yellow pine, easy of access.

Forested and other areas in T. 32 S., R. 10 E., Oregon.

	Acres.
Forested area	23,040
Nonforested area (thin stands of lodgepole pine)	3,000
Logged area	None.

Total stand of timber in T. 32 S., R. 10 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	120,000,000	154,800,000

Composition of forest in T. 32 S., R. 10 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	90
Lodgepole pine	10

TOWNSHIP 32 SOUTH, RANGE 11 EAST.

This township is situated east of the Cascades, and comprises in the western and southern areas flat, pumice-covered bottom lands bordering the Williamson River, nonforested, and producing large quantities of forage. The eastern portions of the township are formed of rolling, pumice-covered lava hills, radiating from the Yamsay Range, and bear stands of yellow pine, easy of access, of medium quality, much cut up, and intersected by stands of lodgepole pine, which are reforestations after fires. These lodgepole growths have been badly burned in recent years. The yellow pine is fire marked throughout.

Forested and other areas in T. 32 S., R. 11 E., Oregon.

	Acres.
Forested area	15, 340
Nonforested area (burned, 2,000; marsh and meadow, 5,700)	7, 700
Badly burned area	4, 000
Logged area	None.

Total stand of timber in T. 32 S., R. 11 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	70, 000, 000	88, 000, 000

Composition of forest in T. 32 S., R. 11 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	75
Lodgepole pine	25

TOWNSHIP 32 SOUTH, RANGE 12 EAST.

The lands in this township comprise low, rolling, pumice-covered slopes situated on the eastern declivities of the Yamsay Range.

The mill timber is exclusively yellow pine, fire marked throughout, easy of access from the Sycan, hence from the Sprague River Valley; of medium quality, much intersected by lodgepole-pine reforestations after fires; the lodgepole stands extensively invaded by recent fires which have utterly destroyed them in many places, giving rise to fire glades chiefly covered with brush.

Forested and other areas in T. 32 S., R. 12 E., Oregon.

	Acres.
Forested area	23, 040
Badly burned area	5, 000
Logged area	None.

Total stand of timber in T. 32 S., R. 12 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	175, 000, 000	197, 800, 000

Composition of forest in T. 32 S., R. 12 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	85
Lodgepole pine	14. 5
White fir, etc	Scattered trees.

TOWNSHIP 32 SOUTH, RANGE 13 EAST.

This township consists of low, pumice-covered lava slopes in its western areas belonging to the Yamsay Range. The central portions comprise flat or gently rolling, pumice-covered levels, while the eastern sections consist of marshy tracts belonging to Sycan Marsh.

The higher levels of the Yamsay Range carry stands of yellow pine of medium quality; the intermediate levels bear lodgepole-pine growths which are mostly reforestations after ancient fires, but are extensively invaded by fires of modern origin.

Forested and other areas in T. 32 S., R. 13 E., Oregon.

	Acres.
Forested area	14, 040
Nonforested area (marsh)	9, 000
Badly burned area	2, 600
Logged area	None.

Total stand of timber in T. 32 S., R. 13 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	75, 000, 000	91, 500, 000

Composition of forest in T. 32 S., R. 13 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	35
Lodgepole pine	65

TOWNSHIP 32 SOUTH, RANGE 14 EAST.

This township comprises chiefly marsh lands belonging to the Sycan, and is situate east of the Yamsay Range. It was not personally examined, but was estimated from information.

Forested and other areas in T. 32 S., R. 14 E., Oregon.

	Acres.
Forested area	13,040
Nonforested area (marsh)	10,000
Logged area	None.

Total stand of timber in T. 32 S., R. 14 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	18,000,000	32,000,000

Composition of the forest in T. 32 S., R. 14 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	10
Lodgepole pine	90

TOWNSHIP 33 SOUTH, RANGE 2 WEST.

This township was not examined personally, but was estimated from information.

Forested and other areas in T. 33 S., R. 2 W., Oregon.

	Acres.
Forested area	22,040
Nonforested area	1,000
Logged area (culled)	3,000
Badly burned area	6,000

Total stand of timber in T. 33 S., R. 2 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	77	20,000,000	40,000,000
Red fir	23	6,000,000	11,000,000
Total	....	26,000,000	51,000,000

TOWNSHIP 33 SOUTH, RANGE 1 WEST.

This township comprises chiefly terminations of spurs coming into the Rogue River Valley from the Umpqua-Rogue River divide.

Near the Rogue River the ridges and slopes are low and rocky, with light stands of timber much mixed with many oak copses. Farther back from the river the ridges grow higher, with less oak and heavier stands of pine and fir. Along the creeks and on the benches near the river are settlements in clearings. Fires have run throughout, and 20 per cent of the timber has been culled and cut for domestic and sawmill uses.

The mill timber remaining is of medium quality. Most of the red fir is of small diameters and the yellow pine is usually short bodied.

Forested and other areas in T. 33 S., R. 1 W., Oregon.

	Acres.
Forested area	20, 240
Nonforested area (glades and agricultural)	2, 800
Badly burned area	3, 500
Logged area (culled)	7, 000

Total stand of timber in T. 33 S., R. 1 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	59. 4	38, 000, 000	60, 000, 000
Sugar pine	4. 7	3, 000, 000	3, 000, 000
Red fir	35. 9	23, 000, 000	47, 000, 000
Total		64, 000, 000	110, 000, 000

Composition of forest in T. 33 S., R. 1 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	40
Sugar pine	. 4
Red fir	53
Oak, madrona, etc	6. 6

TOWNSHIP 33 SOUTH, RANGE 1 EAST.

Rogue River runs through this township in a southwesterly direction, and the region comprises chiefly rocky and steep slopes on both sides of the river.

The forest has been extensively burned in recent times, and large areas are brush covered in consequence.

The mill timber is badly fire marked and is of inferior quality as a whole.

Forested and other areas in T. 33 S., R. 1 E., Oregon.

	Acres.
Forested area	18, 640
Nonforested area (agricultural and meadow, 3,000; burned, 1,400)	4, 400
Badly burned area	9, 600
Logged area (culled)	2, 500

Total stand of timber in T. 33 S., R. 1 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	34. 1	15, 000, 000	20, 520, 000
Sugar pine	6. 8	3, 000, 000	3, 000, 000
Red fir	59. 1	26, 000, 000	33, 000, 000
White fir			1, 500, 000
Incense cedar			500, 000
Total		44, 000, 000	58, 520, 000

Composition of forest in T. 33 S., R. 1 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	30
Sugar pine	.5
Red fir	64.
White fir Incense cedar Oak Madroña	5. 5

TOWNSHIP 33 SOUTH, RANGE 2 EAST.

The northern areas of the township consist of rocky, bare, or sparsely timbered slopes draining southward into Rogue River. The southern portions comprise moderately high and steep slopes draining partly into Rogue River, partly into Big Butte Creek.

Half of the township is fire marked, the destruction having been the greatest in the northern portion. The timber on these tracts is small and of little value. The southern sections contain heavy bodies of red fir of large growth with intermixed patches of sugar pine, most of which are veterans.

Forested and other areas in T. 33 S., R. 2 E., Oregon.

	Acres.
Forested area	20, 540
Nonforested area (glades and agricultural)	2, 500
Badly burned area	1, 800
Logged area	500

Total stand of timber in T. 33 S., R. 2 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	12	18,000,000	24,000,000
Sugar pine	2.7	4,000,000	4,600,000
Red fir	80.6	121,000,000	156,000,000
White fir	3.3	5,000,000	16,000,000
Incense cedar	.4	500,000	800,000
Western hemlock	1	1,500,000	2,400,000
Total		150,000,000	203,800,000

Composition of forest in T. 33 S., R. 2 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	12
Sugar pine	2
Red fir	75
White fir	8
Incense cedar Western hemlock Yew Oak, madroña	3

Township 33 South, Range 3 East.

This township consists of a plateau region bordering the South and the Middle Fork of Rogue River and the nearly level country between these two forks, together with a broken region in the southern areas draining into the waters of Big Butte Creek.

The northern and central areas bear a forest of very massive proportions; the southern sections carry stands which are comparatively light and much broken by grassy glades and brush growths after fires in recent times. Red fir predominates. It is largely composed of standards, with here and there a group of veterans, frequently with diameters up to 8 feet. The sugar pine occurs throughout and is chiefly composed of veteran stands. Reforestations in the southern areas show a remarkably large percentage of white pine, which, however, is limby and knotty.

The forest in this township is much the heaviest in all the country covered by this report, and shows to some extent the capacity of the region in the line of forest growth where reasonably free from destructive fires. But heavy as is the forest it can not be considered as representing a "fully stocked" area. Fires burned here last summer, destroying much timber. They owed their origin to deer hunters.

To obtain a hundred or two hundred pounds of venison several millions of feet of timber were destroyed.

Forested and other areas in T. 33 S., R. 3 E., Oregon.

	Acres.
Forested area	19, 840
Nonforested area (burned, 2,500; glades, 700)	3, 200
Badly burned area	4, 200
Logged area (culled for domestic purposes)	600

Total stand of timber in T. 33 S., R. 3 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	1. 7	10, 000, 000	16, 000, 000
Sugar pine	15. 6	90, 000, 000	99, 500, 000
White pine	. 5	3, 000, 000	6, 000, 000
Red fir	77. 5	450, 000, 000	610, 500, 000
White fir	3. 5	20, 000, 000	65, 000, 000
Incense cedar	. 5	2, 000, 000	3, 000, 000
Western hemlock	. 6	3, 000, 000	6, 880, 000
Total		578, 000, 000	806, 880, 000

Composition of forest in T. 33 S., R. 3 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	2
White pine	. 2
Sugar pine	12
Red fir	75
White fir	10
Incense cedar	. 1
Western hemlock	. 2
Yew and madroña	. 5

TOWNSHIP 33 SOUTH, RANGE 4 EAST.

This township is situated wholly on the western slope of the Cascades, its areas consisting almost entirely of a series of broad, flat terraces between the Middle Fork and South Fork of Rogue River. The canyons of these streams are sunk 300 or 400 feet below the terrace levels, but where the terraces end on the north side of the Middle Fork a lava rim rises to a height of 2,000 feet above the bottom of the canyon.

There are no agricultural or grazing lands in the township.

The run-off flows out by way of the two Rogue River forks. There are no other streams. They carry a large volume of water, have a swift current, and their beds are littered with large bowlders. The South Fork is much the worse in this respect, as it heads in regions that have been subjected to intense glaciation.

The forest belongs to the red-fir type. It has been terribly devastated by fires of modern origin and contains but a fraction of the mill timber that it formerly did. Owing to its location between the two forks of Rogue River access to it for purposes of logging is extremely difficult.

Forested and other areas in T. 33 S., R. 4 E., Oregon.

	Acres.
Forested area	13,140
Nonforested area (chiefly burns)	9,900
Badly burned area	11,000
Logged area	None.

Total stand of timber in T. 33 S., R. 4 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			1,000,000
Sugar pine	5	4,000,000	6,500,000
Red fir	95	76,000,000	108,000,000
White fir			12,480,000
Total		80,000,000	127,980,000

Composition of forest in T. 33 S., R. 4 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	Scattered trees.
Sugar pine	5
White pine	Scattered trees.
Red fir	80.8
White fir	10.2
Incense cedar, yew, etc	4

TOWNSHIP 33 SOUTH, RANGE 5 EAST.

Twenty thousand acres of this township are situated on the west slopes of the Cascades and about 3,000 acres on the eastern declivities. The crest line of the range lies along the east line of the township, except in the northeast and southeast corners, where a slight deviation to the west places portions of the township on the eastern slopes of the range.

The western and central areas consist of rocky and precipitous tracts. Especially noteworthy in this respect is the canyon of the Middle Fork of Rogue River. This stream heads in the south-central areas, with three main branches. The northern one lies in a broad shallow canyon not particularly remarkable, but the southern branch runs in a canyon that has for its west or southwest wall a bluff of lava nearly 2,000 feet in thickness or height. This great mass appears to have issued from two of the craters belonging to the group of five mentioned as occurring in T. 34 S., R. 5 E. The wall of lava presents an immense front to the east, its slopes are extremely steep and rocky and sparsely covered with timber. The opposite or eastern side of the canyon, the course of the stream being northerly in this township, consists of broken terraces and spurs having a moderately easy gradient to the summit of the range. In the northwest corner of the township the stream bends abruptly to the west. The north wall of the canyon is here formed by the front of a mass of lava projected southward from the volcanic area around Union Peak 10 or 12 miles to the north. The front of this lava flow has a thickness from the bottom of the canyon to its summit of nearly 2,800 feet. The eastern portions of the township are formed by the summit of the Cascades. In the southern sections the summit consists of a steep, narrow ridge of lava which ends in the central sections, where the crest is either a succession of narrow lava terraces or a level expanse, in some places fully a mile in width. In the southern portions of the township begins the pumice deposit, which from now on northward covers most of the summit and higher slopes of the range.

The run-off from this township is large. It is probably greater in volume than all the visible drainage from the twelve townships in the reserve south of this one. The outflow is all by way of the Middle Fork of Rogue River. Two of the chief affluents of the fork head directly against the crest of the Cascades. The southern of the two branches has its head in a number of small lakes which are sunk in the hollows of various extinct craters. The northern branch originates in a series of springs, hundreds in number, many of them with a large volume of water. They issue from cracks in a towering bluff of lava, and form a good-sized river in the space of a quarter mile. In addition to these chief branches there are many smaller creeks in the township which feed the volume of the Middle Fork.

No land fit for agriculture exists in the township nor anything that can properly be classed as grazing lands. Some of the fire glades bear scant growth of grass, and sedgy margins border many of the little creeks near the summit of the range. No cattle or sheep are pastured in the township. None of the areas are mineral bearing.

The forest is strictly of the alpine-hemlock type. It has been badly burned and is fire marked throughout. More than half of it is burned to the extent of 50 per cent and over and 25 per cent has been totally destroyed. I doubt if there is a tract of forest as large as 100 acres not fire marked. Reforestation is extremely scanty. Where the forest has not been completely destroyed a thin, sparse growth of lodgepole pine and alpine hemlock is struggling to maintain itself against heavy snows and winds. Where the timber has suffered total destruction low brush growths are covering the ground. The most prominent and abundant species of brush in these growths is the thin-leaved huckleberry—the common huckleberry of all this region. About 2,500 or 3,000 acres of the township have been transformed from forest into a huckleberry patch.

The mill timber is generally of small stature and diameter. An exception is the alpine hemlock in the canyon of the North Branch of the Middle Fork. The growth is remarkably large, but is overmature and in a state of decay. Much of the stand is from 80 to 100 feet in height, 2 to 3 feet in diameter at the base, with clear trunks 30 to 60 feet long. Throughout all of its parts the township is entirely inaccessible for logging operations.

Forested and other areas in T. 33 S., R. 5 E., Oregon.

	Acres.
Forested area	16, 540
Nonforested area (bare rocks 700; burned 5,800)	6, 500
Badly burned area	9, 500
Logged area	None.

Total stand of timber in T. 33 S., R. 5 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Alpine hemlock	84. 4	65, 000, 000	108, 000, 000
Noble fir	13	10, 000, 000	14, 300, 000
Engelmann spruce	2. 6	2, 000, 000	2, 000, 000
Total		77, 000, 000	124, 300, 000

Composition of forest in T. 33 S., R. 5 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Alpine hemlock	85
Noble fir	12
Lodgepole pine Alpine fir Engelmann spruce	3

TOWNSHIP 33 SOUTH, RANGE 6 EAST.

This township lies almost entirely on the eastern slope of the Cascades, a small area in the western sections, which are situated on the summit of the range, overlapping on the western slope. The summit of the Cascades here consists of a broad pumice-covered tract, quite level in some places, in other localities intersected with low combs of lava sloping off toward the eastern foot of the range in a succession of narrow terraces. Dotting the summit here and there are a number of small, flat-topped volcanic cones long extinct, but geologically of recent origin. With the exception of steep breaks of the terraces and ridges along the summit the region is deeply covered with a mantle of pumice débris. The central portions of the township consist in part of terraced lava flows from the main range, and in part of great spurs of volcanic rock ejected from vents along the slopes of the range. The eastern portions comprise flat, muddy, and partly overflowed lands bordering the swampy areas which fringe the north end of Upper Klamath Lake.

The run-off from the township is mostly carried by Sevenmile Creek, a stream heading exactly on the summit of the Cascades in a low, broad, flat saddle to the northwest of Klamath Point. Its head lies close up against the headwaters of the middle of the three branches of the Middle Fork of Rogue River. The topographical arrangement of the region is such that it would be an easy matter to cause a considerable volume of the water now going into the Middle Fork to flow into the canyon of the Sevenmile, and a cut 50 or 75 feet in depth through the pumice crest of the range would divert most of the upper drainage of this branch of the Middle Fork over to the eastern slope. None of the streams in the township is utilized for irrigation purposes.

About 1,000 acres in the northeast sections of the township can be put to grazing and agricultural use. Most of this tract is covered with lodgepole pine, and portions are periodically subject to overflow from Sevenmile Creek. This area is already occupied by settlers. Outside of this there are no grazing or agricultural lands in the township.

All three of the forest types belonging to the region are represented. The yellow-pine type is the prevailing one at the lowest and middle elevations. The red-fir type occurs as small stands interspersed among the yellow pine. At all the higher altitudes alpine hemlock is the prevailing forest type. Fires have marked the entire forested area in the township, and have swept clean of living timber large tracts. At high elevations there is a slow reforestation process setting in, with lodgepole pine as the leading component. At middle and low elevations brush growths are in the ascendancy on the burned-over tracts.

The mill timber is of poor quality throughout. Most of it is inaccessible for logging operations.

Forested and other areas in T. 33 S., R. 6 E., Oregon.

	Acres.
Forested area	12, 940
Nonforested area (chiefly the result of fires)	10, 100
Badly burned area	8, 000
Logged area	None.

Total stand of timber in T. 33 S., R. 6 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	14.8	4,000,000	8,000,000
Sugar pine	11.1	3,000,000	3,000,000
White pine	7.4	2,000,000	2,000,000
Red fir			1,000,000
White fir			10,000,000
Noble fir	11.1	3,000,000	5,000,000
Alpine hemlock	55.5	15,000,000	23,000,000
Engelmann spruce			400,000
Total		27,000,000	52,400,000

Composition of forest in T. 33 S., R. 6 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	3
Sugar pine	1
White pine	.8
Lodgepole pine	30
Red fir	.1
White fir	15
Noble fir	10
Alpine fir	.03
Alpine hemlock	39
Engelmann spruce	.1

TOWNSHIP 33 SOUTH, RANGE 7½ EAST.

This township is situated east of the Cascade main range. The eastern areas of the township consist of a level or slightly rolling lava plateau elevated 600 or 700 feet above the level of the nearby Upper Klamath Lake. This tract bears a moderately heavy stand of fair quality yellow pine.

The western and central portions of the township comprise level, marshy, or lodgepole-pine covered tracts, carrying stands of yellow pine where they join the plateau sections in the eastern areas, with the mill timber long since cut away and used in the building of Fort Klamath.

Forested and other areas in T. 33 S., R. 7½ E., Oregon.

	Acres.
Forested area	9,040
Nonforested area (meadow, marsh, and agricultural)	14,000
Logged area (culled 95 per cent)	1,000

Total stand of timber in T. 33 S., R. 7½ E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	80	20,000,000	29,000,000
Sugar pine	20	5,000,000	5,000,000
Red fir			100,000
White fir			7,450,000
Incense cedar			850,000
Total		25,000,000	42,400,000

Composition of forest in T. 33 S., R. 7½ E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	34
Sugar pine	1.2
Lodgepole pine	60
Red fir	Scattered trees in the eastern areas.
White fir	4.6
Incense cedar	.2

TOWNSHIP 33 SOUTH, RANGE 7 EAST.

The western and central areas of this township consist of a level or, in a few places, broken lava plateau lying between the Williamson River and the marshes at the north end of Upper Klamath Lake. The eastern portions of the township comprise the canyon-like valley of the Williamson River, with small tracts of the uplands east thereof.

The areas west of the Williamson River carry most of the mill timber. It is principally composed of open yellow-pine stands, of fair quality and easily logged. The eastern areas are much less timbered. The forest is thin and is broken by numerous grassy glades along the Williamson River. It is fringed with thin stands of lodgepole pine.

The forest is fire marked throughout. Young growth is scanty, and there is but little underbrush in the forest.

The soil is a fine pumice detritus.

Forested and other areas in T. 33 S., R. 7 E., Oregon.

	Acres.
Forested area	21,440
Nonforested area (meadow, glade, and rocks)	1,600
Badly burned area	2,000
Logged area	None

Total stand of timber in T. 33 S., R. 7 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	98.9	180,000,000	197,820,000
Sugar pine	1.1	2,000,000	2,000,000
White fir			4,000,000
Incense cedar			500,000
Total		182,000,000	204,320,000

Composition of forest in T. 33 S., R. 7 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	75
Sugar pine	1
Lodgepole pine	20
White fir	2
Incense cedar Cottonwood, etc	2

TOWNSHIP 33 SOUTH, RANGE 8 EAST.

This township consists of pumice-covered lava ridges and slopes situated east of the Williamson River.

The forest is fire marked throughout. The stand of timber is open and is second rate in quality, the larger proportion being composed of small standards much damaged by the numerous fires which have swept through the forest both in recent and in past times.

Forested and other areas in T. 33 S., R. 8 E., Oregon.

	Acres.
Forested area	22,440
Nonforested area (meadow and agricultural)	600
Badly burned area	3,500
Logged area	None.

Total stand of timber in T. 33 S., R. 8 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	120,000,000	147,980,000

Composition of forest in T. 33 S., R. 8 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	95
Lodgepole pine	5

Township 33 South, Range 9 East.

This township is situated east of the Cascade Range, and consists of low, pumice-covered lava ridges rising from elevations of 600 feet to elevations of 1,200 feet above the adjacent areas of Klamath Marsh.

The northern portions of the township contain numerous glades, formed by southward extensions of Klamath Marsh, nonforested, and fringed by stands of lodgepole pine.

The mill timber occurs on the higher slopes. It is fire marked throughout, is of medium quality, and easy of access. It has small interruptions of lodgepole pine, which are reforestations after fires.

Forested and other areas in T. 33 S., R. 9 E., Oregon.

	Acres.
Forested area	16,940
Nonforested area (grassy glades with scattered trees of lodgepole pine)	6,100
Logged area	None.

Total stand of timber in T. 33 S., R. 9 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	50,000,000	101,800,000

Composition of forest in T. 33 S., R. 9 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	80
Lodgepole pine	19.5
White fir	.5

Township 33 South, Range 10 East.

This township consists of low pumice-covered slopes and ridges having a general rise toward the south where they form, in part, the divide between the Williamson and the Sprague rivers.

The forest is fire marked throughout. It consists of stands of yellow pine of fair quality, above medium density, moderately easy of access from the Williamson Valley side. It is mixed with stands of lodgepole pine and along the crests of the ridges with a thin sprinkling of white fir.

Forested and other areas in T. 33 S., R. 10 E., Oregon.

	Acres.
Forested area	22,840
Nonforested area (glades)	200
Logged area	None.

Total stand of timber in T. 33 S., R. 10 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	200,000,000	250,600,000

Composition of forest in T. 33 S., R. 10 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	90
Lodgepole pine	9.5
White fir	.5

TOWNSHIP 33 SOUTH, RANGE 11 EAST.

The northern portions of this township consist, in part, of low, level grass-covered slopes bordering the Williamson River, and, in part, of low pumice slopes which help form the Williamson-Sycan divide. The southern areas comprise broken, rocky, or pumice-covered ridges with a central nucleus in Fuego Mountain, an extinct volcano.

The forest along the Williamson River bottoms consists chiefly of stands of small lodgepole pine of various ages. The slopes and ridges carry yellow-pine stands which have been much eaten into by ancient fires whose paths now carry lodgepole-pine reforestations, in their turn ravaged by fires of recent times to the extent of 80 per cent. The mill timber is of fair quality, but contains a large proportion under standards in size.

Forested and other areas in T. 33 S., R. 11 E., Oregon.

	Acres.
Forested area	21,740
Nonforested area (marsh and glade)	1,300
Badly burned area	5,000
Logged area	None.

Total stand of timber in T. 33 S., R. 11 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	62,000,000	131,800,000

Composition of forest in T. 33 S., R. 11 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	60
Lodgepole pine	39
White fir	1

Township 33 South, Range 12 East.

This township consists chiefly of nearly level areas deeply covered with pumice and cut by numerous grassy glades along small creeks.

The township contains a small bunch of yellow-pine stands of poor quality in the northwest corner. The balance of the township is covered with stands of lodgepole pine burned to the extent of 65 per cent by fires in recent times, and carrying here and there small scattered stands of yellow pine of little or no commercial value.

Forested and other areas in T. 33 S., R. 12 E., Oregon.

	Acres.
Forested area	21,040
Nonforested area (glades)	2,000
Badly burned area	11,500
Logged area	None.

Total stand of timber in T. 33 S., R. 12 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	25,000,000	53,000,000

Composition of forest in T. 33 S., R. 12 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	10
Lodgepole pine	90

Township 33 South, Range 13 East.

This township consists of a lava plateau to the south of Sycan Marsh. It is in part covered with many narrow, low, and irregular ridges of pumice detritus; in part, through surface denudation and removal of the pumice covering, it consists of large areas with a surface of the rough, underlying lava.

The forest consists of thin stands of yellow and lodgepole pine. The rocky flats between the pumice ridges carry mostly scattered trees. The mill timber occurs on and follows the pumice dunes. It is of poor quality throughout.

Forested and other areas in T. 33 S., R. 13 E., Oregon.

	Acres.
Forested area	16,040
Nonforested area (meadow, marsh, and glade)	7,000
Badly burned area	2,200
Logged area	None.

Total stand of timber in T. 33 S., R. 13 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	10,000,000	24,000,000

Composition of forest in T. 33 S., R. 13 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	65
Lodgepole pine	35

Township 33 South, Range 14 East.

The township is situate southward from Sycan Marsh and comprises mostly flats covered with lodgepole pine. The forest is chiefly composed of lodgepole pine. This township was not examined personally, but estimated from information.

Forested and other areas in T. 33 S., R. 14 E., Oregon.

	Acres.
Forested area	13,040
Nonforested area (marsh)	10,000
Logged area	None.

Total stand of timber in T. 33 S., R. 14 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	4,000,000	10,000,000

Township 34 South, Range 2 West.

The eastern areas of this township consist of bench lands bordering Rogue River. They are thinly forested or quite bare of timber. The western portions consist of low spurs projecting southward from the Umpqua-Rogue River divide, and bear most of the forest.

The region is fire marked throughout. The mill timber is scattered and of poor quality, having largely been culled during many years for domestic purposes.

Forested and other areas in T. 34 S., R. 2 W., Oregon.

	Acres.
Forested area	21,040
Nonforested area (agricultural and grazing)	2,000
Badly burned area	3,000
Logged area (culled)	5,000

Total stand of timber in T. 34 S., R. 2 W., Oregon.

Species.	Local practice.		Michigan practice
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	66.6	6,000,000	16,000,000
Sugar pine			1,500,000
Red fir	33.4	3,000,000	5,000,000
Incense cedar			500,000
Total		9,000,000	23,000,000

Composition of forest in T. 34 S., R. 2 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	80
Red fir	15
Sugar pine Incense cedar Oaks, etc	5

Township 34 South, Range 1 West.

This township comprises a mass of low, broken lava and serpentine spurs situated between Rogue River and Big Butte Creek.

The forest is light, open, and is largely composed of oak copses, much of the more valuable mill timber having long since been cut away. The slopes fronting on Rogue River have been badly burned and are grown up with brush.

Forested and other areas in T. 34 S., R. 1 W., Oregon.

	Acres.
Forested area	20,540
Nonforested area (agricultural and grazing)	2,500
Badly burned area	1,500
Logged area (culled)	15,000

Total stand of timber in T. 34 S., R. 1 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	3,000,000	12,000,000
Red fir			4,000,000
Total		3,000,000	16,000,000

Composition of forest in T. 34 S., R. 1 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	85
Red fir	10
White fir Oak Cottonwood	5

Township 34 South, Range 1 East.

This township consists of low, rocky, broken slopes and ridges draining into Big Butte Creek, which nearly bisects the township.

The forest is thin and scanty. The western half of the township is mostly covered with copses of low scrub oaks. The eastern areas, which formerly bore good stands of timber, have been largely logged clean, or rather closely culled.

Forested and other areas in T. 34 S., R. 1 E., Oregon.

	Acres.
Forested area	16,640
Nonforested area (agricultural and rocks, 5,000; burned, 1,400)	6,400
Badly burned area	2,000
Culled area (20 to 60 per cent)	6,000
Logged area	6,000

Total stand of timber in T. 34 S., R. 1 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	38.1	8,000,000	12,000,000
Sugar pine	14.3	3,000,000	3,480,000
Red fir	47.6	10,000,000	15,410,000
White fir			3,910,000
Total		21,000,000	34,800,000

Composition of forest in T. 34 S., R. 1 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	38
Sugar pine	8
Red fir	50
White fir Incense cedar Oak, etc	4

TOWNSHIP 34 SOUTH, RANGE 2 EAST.

The central portion of this township is formed by the divide between the Big Butte Creek and its northern fork. The western and eastern sections consist of the west and east slopes of this ridge.

The upper western slopes, the summit, and the eastern slopes of the ridge carry heavy stands of an excellent quality of mill timber where not burned. The lower slopes on the western side are mostly barren or rocky, and are lightly timbered or have had their forest logged off.

Fires have run through about one-half of the township, badly burning portions of the western slope. The results have been brush-covered areas, slowly reforesting with red fir.

Forested and other areas in T. 34 S., R. 2 E., Oregon.

	Acres.
Forested area	19, 240
Nonforested area (agricultural and grazing)	3, 800
Badly burned area	2, 800
Logged area	3, 000

Total stand of timber in T. 34 S., R. 2 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	Feet B. M.	Feet B. M.
Yellow pine	20	28, 000, 000	34, 000, 000
Sugar pine	8	11, 000, 000	12, 000, 000
Red fir	68. 9	95, 000, 000	118, 000, 000
White fir	2. 3	3, 000, 000	10, 000, 000
Incense cedar	. 8	1, 000, 000	1, 690, 000
Western hemlock			1, 000, 000
Total		138, 000, 000	176, 690, 000

Composition of forest in T. 34 S., R. 2 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	20
Sugar pine	8
Red fir	65
White fir	5
Incense cedar Western hemlock Oaks, yew	2

Township 34 South, Range 3 East.

This township is situated on slopes draining partly into the North Fork of Big Butte Creek and partly into the Middle Fork of Rogue River. The region is much cut up by numerous low ridges and narrow canyons.

Fires have run throughout the township in recent times; there being few tracts not fire marked. Reforestation is good in the western and central areas, but deficient in the eastern, where brush growths are apt to prevail after fires. Most of the mill timber occurs in the western areas. It is of fair quality, but contains a large amount of material with deficient clear trunk development. It is comparatively easy of access.

Forested and other areas in T. 34 S., R. 3 E., Oregon.

	Acres.
Forested area	20,540
Nonforested area (glades, 500; burned, 2,000)	2,500
Badly burned area	3,200
Logged area (culled for domestic purpose)	500

Total stand of timber in T. 34 S., R. 3 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	19.1	50,000,000	90,000,000
Sugar pine	7.7	20,000,000	24,000,000
Red fir	67	175,000,000	234,000,000
White fir	4.6	12,000,000	38,000,000
Western hemlock			1,000,000
Incense cedar	1.5	4,000,000	5,360,000
Total		261,000,000	392,360,000

Composition of forest in T. 34 S., R. 3 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	15.
Sugar pine	5.
Red fir	60.
White fir	18.5
Western hemlock	.05
Incense cedar	1.

Township 34 South, Range 4 East.

The position of this township is west of the main range of the Cascades. It is separated from the slopes leading directly to the summit of the range by the intervening canyon of South Fork of Rogue River. This canyon enters the township at its southeastern corner and cuts across it in a northwesterly direction. About two-thirds of the township areas are comprised in the bottom and slopes of this canyon. The remainder, the western sections, consists of western declivities of the divide between South Fork of Rogue River and North Fork of Big Butte Creek. Almost the entire area of the township is rocky and abounds in precipitous slopes. Where these have a more gentle gradient they are strewn with bowlders and smaller fragments of glaciated lava. The ridge which bounds the South Fork Canyon on the west is especially rocky and bowlder strewn. The bottom of the canyon is littered with glacial débris, such as lava blocks torn off the inclosing canyon walls or transported from the base of Mount Pitt. There are also gravel terraces, which mark the former existence of lateral and terminal moraines.

The drainage of the township flows into Rogue River, most of it by way of the South Fork of this stream, only an inconsiderable quantity by way of North Fork of Big Butte Creek. The volume of water in the Rogue River Fork is small until near its point of exit from the township, where it is greatly augmented by the entrance of a large tributary from the east and by the quantity received from numerous big springs issuing from under the lava.

The township contains no agricultural land. The grazing areas consist of fire glades in the western portions—slopes which were burned over thirty or forty years ago and have neither become reforested nor grown up to brush, but are covered with a scanty sward of coarse grass or sedge. Cattle in small numbers range on these fire glades. No sheep are pastured in the township. None of the lands are mineral bearing so far as known.

The forest in the township consists mainly of stands belonging to the alpine-hemlock type. Small tracts bearing stands of red-fir type occur in the southwest corner. Most of the timber is of small size, averaging less than 18 inches in basal diameter, and is defective from various forms of rot due to severe and often recurring fires.

Forest fires have ravaged large areas of the township. The larger portions of the central regions have been utterly laid waste through this cause, the burns being northward extensions of the great fire-swept areas in township 35 adjoining on the south. On slopes facing west brush growths are covering the burned-over land with almost impenetrable thickets of chaparral. On eastern declivities leading into the South Fork of Rogue River Canyon are large tracts on which neither tree nor brush has as yet obtained a lodgment, nothing but a scant growth of weeds marking the site of the burned forest.

Forested and other areas in T. 34 S., R. 4 E., Oregon.

	Acres.
Forested area	15,340
Nonforested area (chiefly burned clean)	7,700
Badly burned area	8,000
Logged area	None.

Total stand of timber in T. 34 S., R. 4 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	4.9	3,000,000	6,500,000
Red fir	13.1	8,000,000	13,000,000
White fir			2,800,000
Noble fir	32.8	20,000,000	25,000,000
Alpine hemlock	32.8	20,000,000	40,000,000
Engelmann spruce	16.4	10,000,000	21,000,000
Total		61,000,000	108,300,000

Composition of forest in T. 34 S., R. 4 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	3
Sugar pine	Scattered trees.
White pine	Scattered trees.
Lodgepole pine	10
Red fir	4
White fir	2
Noble fir	20
Alpine fir	1
Alpine hemlock	40
Engelmann spruce	20

TOWNSHIP 34 SOUTH, RANGE 5 EAST.

The lines of this township include areas situated on both sides of the crest of the main range of the Cascades. The summit of the range strikes through the central sections, almost in a straight north-south line. The crest of the range in this township consists of an old lava flow about three-fourths of a mile in width which appears to have come from a group of now extinct craters situated near the northern boundary. This lava stream shows marks of past glaciation; it is thinly covered with soil and in some places is extremely rough with loose blocks and bowlder accumulations. The western sections of the township consist of rough, rocky slopes descending into the canyon of the South Fork of Rogue River. A glaciated lava plateau abounding in low, intersecting morainic ridges of rough lava blocks comprises the southern portion of the eastern sections. Scattered over the surface of the plateau are scores of lakelets sunk in shallow depressions or held between ridges of glacial origin. Most of these lakelets have no visible outlet. The northern portion of the eastern areas of the township consists, in part, of the upper portion of Cherry Creek Canyon, a drainage channel largely owing its existence to glacial erosion, its bottom sunk a thousand feet below the level of the plateau through which it has been cut, and opening into the marshy areas of Upper Klamath Lake. The remainder of the township comprises rough lava fields and high ridges which represent the remains of crater rims and interiors of a huge group of extinct volcanic vents. The group of craters here referred to, situated in the north-central portions of the township, forms one of the most interesting and remarkable of all the volcanic centers in this part of the Cascade Range, Originally it consisted of five craters grouped around a nucleus of very ancient lava which undoubtedly was ejected from still older craters. The diameters of the entire system were 3 miles north and south by 5 miles east and west, and the mountain around which the craters are grouped, now appearing as a narrow, jagged, sharp-crested ridge, rises to a height of about 7,200 feet above sea level. Most of the rims of the craters have long since been blown away by volcanic eruptions or cut out by glaciers which appear to have filled the craters to a depth of 1,000 or 1,500 feet. When these volcanoes were active they ejected vast streams of lava on all sides. Two of these streams, one south, the other northeast of the group, now constitute the crest of the Cascades in this locality.

The run-off from the township in part flows into Rogue River by way of its South Fork, in part empties into Upper Klamath Lake through Cherry Creek. Apparently, less of the precipitation sinks and more runs away as visible drainage than is the case in the township south, for both of the streams mentioned carry a large volume of water in their courses through the township. Most of the water in Cherry Creek is derived from two large creeks heading in the glaciated plateau area to which allusion has previously been made. These creeks probably are fed by leakage from the many lakes which dot the plateau surface. Numerous lakelets and pools are found among the group of five craters. Some of them are situated in depressions in the ancient vents, others are perched high up in little niches or on narrow benches and terraces which have been excavated in the precipitous walls of the cliffs by glacial agencies. The upper portion of Cherry Creek Canyon discloses in great perfection evidences which prove the former existence of moving masses of ice in this valley. They consist of numerous narrow ledges of rock, having their long axis parallel with the direction of the canyon. In some localities these ridges of rock have been smoothly polished by the moving ice masses; in other places they are deeply scored by long, straight groves from west to east, proving that the ice slid toward the basin now covered with Upper Klamath Lake.

There are no agricultural or grazing lands in the township.

The forest belongs to the alpine-hemlock type. Fires have everywhere ravaged it. The upper portion of the Cherry Creek drainage basin and the areas adjacent to the base of the group of extinct volcanoes previously mentioned have been burned very near clean of their forest cover. Most of the standing timber is of small size, being chiefly reforestations after fires which denuded the region a decade or two anterior to the advent of the white man. A large proportion is lodgepole pine. Some consists of small scraggy alpine hemlock and white pine.

The mill timber is of poor quality throughout. The soil is too thin to grow big timber and the numerous fires which have devastated the region have badly damaged what they have not consumed. More than 75 per cent of the stands are composed of trees with basal diameters below 18 inches.

The region is generally inaccessible for logging operations. The only areas that can be reached are the Cherry Creek bottoms along the eastern edge of the township, but the tract does not carry enough timber to pay the cost of constructing roads to reach it.

At the present time no mineral bearing areas are known in the township, but it is not unlikely that ground of this kind may be discovered in the region adjoining the group of ancient volcanoes. Lavas of the kind found in that locality have elsewhere been known to carry gold.

The areal and timber estimates for the township are as follows:

Forested and other areas in T. 34 S., R. 5 E., Oregon.

	Acres.
Forested area	19,140
Nonforested area (bare rocks 2,000, burned 1,900)	3,900
Badly burned area	8,500
Logged area	None.

Total stand of timber in T. 34 S., R. 5 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Noble fir	41.6	5,000,000	10,000,000
Alpine hemlock	50	6,000,000	17,000,000
Engelmann spruce	8.4	1,000,000	4,280,000
Total		12,000,000	31,280,000

Composition of forest in T. 34 S., R. 5 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Lodgepole pine	70
Noble fir	10
Alpine fir	3
Englemann spruce Yew White pine	2
Alpine hemlock	15

Township 34 South, Range 6 East.

The region comprised within the limits of this township is situated on the eastern slope of the Cascades. Most of it is a rocky, barren, desolate tract of country. The western and central portions of the township consist of broad, glaciated terraces of lava flanking the main crest of the Cascades. Along the eastern edge of this terraced region, where it breaks off to the slopes which lead down to the levels at the foot of the range, are ranges of broken, irregular combs and hills, perhaps the remains of ancient crater rims. The eastern sections comprise a narrow, level, bowlder-strewn terrace at the foot of the range and a strip of marshy meadow fringing Upper Klamath Lake.

The region is drained by Threemile and Cherry creeks; of the latter only the lower portion lies within the lines of this township. There also are a few insignificant rivulets and small springs. Cherry Creek carries a large volume of water during spring and early summer, but later diminishes very much in size; Threemile Creek is a stream of trifling proportions. The waters of both creeks are utilized for irrigation purposes in a small way by ranchers in the vicinity. It is self-evident that most of the rain water falling on the areas of this township sinks in crevices of the lava and is lost, for Cherry Creek, the largest stream in the township, gets most of its water from the next township west and south, and the outflow in other localities is trifling in amount.

There are a few hundred acres of land that by a stretch of imagination can be classed as agricultural. It is all contained in the narrow bowlder terrace at the foot of the range. There are no grazing lands in the mountain areas. The lava ridges and terraces in those portions of the township are mostly too barren and rocky to sustain even a grass or sedge growth.

The forest consists of stands of red-fir and of yellow-pine types at low elevations, while at high altitudes and in the wet and swampy bottoms of Middle Cherry Creek the alpine-hemlock type is the prevailing one. The yellow pine is of fair quality and is only moderately difficult of access. The greatest quantity and the largest dimensions occur at the mouth of Cherry Creek. Most of the really valuable mill timber in the township exists in the bottoms and on the slopes adjacent to that stream. In some places where the bottoms are swampy there are heavy stands of Engelmann spruce averaging 90 to 110 feet in height, with diameters 3 to 4 feet, 2 feet from the ground, and clear trunks from 40 to 60 feet in length. Mixed with the spruce are numbers of veteran red firs of large size; some were seen with diameters of 7 feet. In the western portions of the township most of the forest is of small dimensions and is chiefly composed of lodgepole pine, alpine hemlock, and noble fir.

Fire has marked the forest in all portions of the township. The damage due to this cause has been especially severe and extensive in the western areas, where most of the destruction has been done since the white man's occupancy of the country. In late years big fires in Cherry Creek Canyon have destroyed 30 per cent of the only really valuable mill timber in the township. About midway up that canyon are large salt or alkali licks that have from time immemorial been the gathering place for all the deer in the surrounding country. A good many hunting parties also come here to slay the deer at the licks; fires are the inevitable result.

Reforestations of the burned-over areas are few and thin. Most of the young forest outside the yellow-pine areas consists of lodgepole pine. Where the yellow-pine stands have been destroyed heavy brush growths of the vellum-leaved ceanothus have followed. On a few of the higher elevations facing east and south the forest has been replaced with a thin sward of grass. In the burns which have occurred in the alpine-hemlock type large tracts are entirely bare of vegetation.

No mineral-bearing areas are known in the township.

Forested and other areas in T. 34 S., R. 6 E., Oregon.

	Acres.
Forested area	13,440
Nonforested area (marsh and rocks, 6,000; burned, 3,600)	9,600
Badly burned area	4,000
Logged area	None.

Total stand of timber in T. 34 S., R. 6 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	20	10,000,000	20,000,000
White pine	2	1,000,000	1,540,000
Red fir	10	5,000,000	8,500,000
White fir	16	8,000,000	38,000,000
Noble fir	34	17,000,000	25,000,000
Alpine hemlock	6	3,000,000	9,000,000
Engelmann spruce	12	6,000,000	8,000,000
Total		50,000,000	110,040,000

Composition of forest in T. 34 S., R. 6 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	20
White pine Lodgepole pine	2
Red fir	8
Noble fir	25
White fir	30
Alpine hemlock	10
Engelmann spruce	5

TOWNSHIP 34 SOUTH, RANGE 7½ EAST.

This township consists chiefly of wet, swampy, and overflowed lands adjoining Upper Klamath Lake, with small areas of higher land in the eastern portions, which bear thin stands of yellow pine of little commercial value. Lodgepole pine fringes all the marshy tracts, with here and there willow and poplar groves.

Forested and other areas in T. 34 S., R. 7½ E., Oregon.

	Acres.
Forested area	1,200
Nonforested area (marsh and lake)	21,840
Logged area	None.

Total stand of timber in T. 34 S., R. 7½ E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			3,600,000

Composition of forest in T. 34 S., R. 7½ E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	30
Lodgepole pine	70

TOWNSHIP 34 SOUTH, RANGE 7 EAST.

This township consists of a lava plateau situated between Upper Klamath Lake and Williamson River, with portions of a similar plateau east of the Williamson in the eastern sections of the township.

The forest is fire marked throughout. The fire glades in the eastern areas are covered with brush or lodgepole pine. In the western portions they are reforesting with yellow pine.

The mill timber is of medium quality, being knotty in the log, although clear in exterior appearance. It is easy of access. The southern areas of the township have practically been logged clean for Indian uses at and around Klamath Agency. The northern portions still carry considerable timber.

Forested and other areas in T. 34 S., R. 7 E., Oregon.

	Acres.
Forested area	17, 280
Nonforested area (marsh and lake)	5, 760
Badly burned area	1, 000
Logged area (95 per cent)	5, 000

Total stand of timber in T. 34 S., R. 7 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	92. 1	35, 000, 000	48, 000, 000
Sugar pine	7. 9	3, 000, 000	3, 000, 000
White fir			2, 000, 000
Incense cedar			240, 000
Total		38, 000, 000	53, 240, 000

Composition of forest in T. 34 S., R. 7 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	95
Sugar pine	1. 8
White fir	3
Incense cedar, etc	. 2

TOWNSHIP 34 SOUTH, RANGE 8 EAST.

This township comprises rocky, flat lava tracts in the northern and central portions, with low ridges of volcanic origin in the southern areas.

The forest is fire marked throughout. The central portions are thinly forested or are bare of timber growth owing to their semiarid conditions.

The mill timber is of inferior quality throughout.

Forested and other areas in T. 34 S., R. 8 E., Oregon.

	Acres.
Forested area	12, 160
Nonforested area (semiarid grazing land)	10, 880
Logged area	None.

Total stand of timber in T. 34 S., R. 8 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	95. 6	15, 000, 000	28, 400, 000
Sugar pine	4. 4	700, 000	700, 000
White fir			1, 300, 000
Total		15, 700, 000	30, 400, 000

Composition of forest in T. 34 S., R. 8 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	85
Lodgepole pine	14
Sugar pine White fir	1

Township 34 South, Range 9 East.

The central and southwestern areas of this township consist of a nearly level, semiarid lava plateau, bordering portions of the Sprague River throughout. With the exception of scattered trees of yellow pine, the tracts are devoid of forest.

The northern and eastern sections of the township comprise low ridges and hills, and bear thin stands of yellow pine of inferior quality.

Forested and other areas in T. 34 S., R. 9 E., Oregon.

	Acres.
Forested area	12,800
Nonforested area (meadow, agricultural, and semiarid)	10,240
Logged area	None.

Total stand of timber in T. 34 S., R. 9 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	12,000,000	30,000,000

Composition of forest in T. 34 S., R. 9 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	98
Lodgepole pine	2

Township 34 South, Range 10 East.

This township consists of rocky lava slopes of the divide between the Williamson and the Sprague rivers.

The forest is open, and the growth is thin and mostly of small dimensions, except in the extreme northern areas, where heavy stands of yellow pine of fair quality occur.

Forested and other areas in T. 34 S., R. 10 E., Oregon.

	Acres.
Forested area	23,040
Logged area	None.

Total stand of timber in T. 34 S., R. 10 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	38,000,000	70,000,000

Composition of forest in T. 34 S., R. 10 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	98
Lodgepole pine	2

TOWNSHIP 34 SOUTH, RANGE 11 EAST.

The southwestern areas of this township are covered with an open growth of yellow pine, and consist mostly of rocky hillsides. The southeastern sections are formed of a comparatively flat, rocky, lava plateau bordering Sycan River, and are nearly devoid of timber. The northern areas comprise slopes of Fuego Mountain, and are covered with medium dense stands of yellow pine of fair quality, but difficult of access. The yellow pine is fire marked throughout, and is mixed with stands of lodgepole pine and scattered trees of white fir.

Forested and other areas in T. 34 S., R. 11 E., Oregon.

	Acres.
Forested area	15,040
Nonforested area (grazing and semiarid)	8,000
Badly burned area	2,100
Logged area	None.

Total stand of timber in T. 34 S., R. 11 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	48,000,000	77,300,000
White fir			1,700,000
Total		48,000,000	79,000,000

Composition of forest in T. 34 S., R. 11 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	90
Lodgepole pine	9
White fir	1

Township 34 South, Range 12 East.

This township consists of rocky lava slopes on the western declivities of a range of hills known as the Black Hills.

Fires have run throughout the township. The timber is chiefly made up of stands of yellow pine of medium density and quality, difficult of access, and interspersed with scattered trees of sugar pine, white fir, small incense cedar, and thin stands of lodgepole pine.

Forested and other areas in T. 34 S., R. 12 E., Oregon.

	Acres.
Forested area	13, 840
Nonforested area (grazing and semiarid, 8,000; burned, 1,200)	9, 200
Badly burned area	3, 000
Logged area	None.

Total stand of timber in T. 34 S., R. 12 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	99	75, 000, 000	94, 000, 000
Sugar pine	1	700, 000	700, 000
White fir			1, 200, 000
Incense cedar			100, 000
Total		75, 700, 000	96, 000, 000

Composition of forest in T. 34 S., R. 12 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	85
Sugar pine	.5
Lodgepole pine	14
White fir	.4
Incense cedar	Scattered trees.
Western juniper	Scattered trees.

Township 34 South, Range 13 East.

This township consists of a rolling, hilly region of little elevation above the near-by Sprague River Valley, formed by the eastward extending spurs of the Black Hills.

The forest is everywhere fire marked; the greatest damage has been done on the immediate eastern slopes of the Black Hills, where in many localities the timber has been totally destroyed and brush growths have taken its place.

The mill timber forms good stands, excellent in quality, and readily accessible from the Sprague River Valley.

Forested and other areas in T. 34 S., R. 13 E., Oregon.

	Acres.
Forested area	23,040
Badly burned area	1,200
Logged area	None.

Total stand of timber in T. 34 S., R. 13 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	93.7	130,000,000	147,000,000
Sugar pine	2.1	3,000,000	3,000,000
White fir	3.6	5,000,000	17,000,000
Incense cedar	.6	800,000	1,000,000
Total	....	138,800,000	168,000,000

Composition of forest in T. 34 S., R. 13 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	85
Sugar pine	.25
Lodgepole pine	5
White fir	9
Incense cedar	.75

TOWNSHIP 34 SOUTH, RANGE 14 EAST.

This township was not examined personally, but was estimated from information.

Forested and other areas in T. 34 S., R. 14 E., Oregon.

	Acres.
Forested area	15,040
Nonforested area	8,000
Logged area	None.

Total stand of timber in T. 34 S., R. 14 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	83.3	25,000,000	40,000,000
Sugar pine	5	1,500,000	1,500,000
White fir	10	3,000,000	8,000,000
Incense cedar	1.6	500,000	500,000
Total	....	30,000,000	50,000,000

TOWNSHIP 35 SOUTH, RANGE 2 WEST.

This township consists of low ridges with open, rolling valleys between, mostly devoid of forest and covered with thick growths of chaparral (*Ceanothus cuneatus*) where not under cultivation. The forested areas carry thin stands and lines of yellow pine, with scattered trees of red fir and numerous copses of low-growing oaks.

The hilly portions were formerly more heavily wooded, but have been swept by fires and transformed into chaparral-covered slopes.

Forested and other areas in T. 35 S., R. 2 W., Oregon.

	Acres.
Forested area	3,000
Nonforested area (meadow, agricultural, and grazing)	20,040
Logged area (culled of its mill timber)	All.

Total stand of timber in T. 35 S., R. 2 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			1,600,000
Red fir			700,000
Total			2,300,000

Composition of forest in T. 35 S., R. 2 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	8
Red fir	.2
Oak, cottonwood, etc	91.8

TOWNSHIP 35 SOUTH, RANGE 1 WEST.

This township consists of low ridges and semiarid flats, mostly draining into Reese Creek, a tributary of Rogue River.

The forest is principally scattered oak copses, with small areas of well-culled yellow pine and red fir in the eastern sections.

The mill timber is small and unimportant.

Forested and other areas in T. 35 S., R. 1 W., Oregon.

	Acres.
Forested area	5,000
Nonforested area (meadow, agricultural, and grazing)	18,040
Badly burned area	800
Logged area (culled)	All.

Total stand of timber in T. 35 S., R. 1 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			3,000,000
Red fir			1,000,000
Total			4,000,000

Composition of forest in T. 35 S., R. 1 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine Red fir	2
Oak	98

Township 35 South, Range 1 East.

This township consists of slopes draining west into Rogue River and east into Big Butte Creek. The western slopes are terraced, rocky benches, thinly forested. The eastern portions of the township slope gradually into Big Butte Valley, and are covered with moderate stands of yellow pine and red fir of inferior quality along the upper levels.

The forest is everywhere fire marked.

Forested and other areas in T. 35 S., R. 1 E., Oregon.

	Acres.
Forested area	10,240
Nonforested area (agricultural and grazing, 11,000; burned, 1,800)	12,800
Badly burned area	1,500
Logged area	4,800

Total stand of timber in T. 35 S., R. 1 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	72.7	8,000,000	14,000,000
Red fir	27.3	3,000,000	8,000,000
White fir			2,000,000
Total		11,000,000	24,000,000

Composition of forest in T. 35 S., R. 1 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	50
Sugar pine	Scattered trees.
Red fir	30
White fir	5
Incense cedar	Scattered trees.
Oak	15

TOWNSHIP 35 SOUTH, RANGE 2 EAST.

This township comprises a mass of steep and broken ridges, situated between the North Fork of Little Butte and the South Fork of Big Butte creeks.

The central and southeastern areas contain the best and heaviest mill timber. It is of fair quality and easy of access.

A large proportion of the township is settled and much of the forest has either been cleared away for agricultural purposes or logged for sawmill and domestic uses. The sugar pine has suffered severely from the shake makers. Millions of feet have been cut down and, proving difficult to split, have been allowed to lie where they fell unused.

Fires have marked the forest everywhere in the township.

Forested and other areas in T. 35 S., R. 2 E., Oregon.

	Acres.
Forested area	19,840
Nonforested area (agricultural and grazing)	3,200
Badly burned area	4,700
Logged area (culled)	6,000

Total stand of timber in T. 35 S., R. 2 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	21.5	20,000,000	28,000,000
Sugar pine	3.2	3,000,000	4,500,000
Red fir	75.3	70,000,000	98,000,000
White fir			11,000,000
Incense cedar			3,600,000
Total		93,000,000	145,100,000

Composition of forest in T. 35 S., R. 2 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	30
Sugar pine	1
Red fir	55
White fir	5
Incense cedar	2
Oak	7

TOWNSHIP 35 SOUTH, RANGE 3 EAST.

This township is situated on the headwaters of the South Fork of Big Butte Creek, and consists of level areas traversed by occasional low ridges; the entire region of volcanic origin.

The central areas contain a large quantity of agricultural and grazing land, most of it settled upon. The balance is covered with a moderately uniform, heavy forest stand, in which yellow pine largely predominates. The mill timber is of good dimensions and quality. The forest is fire marked throughout.

The sugar pine in the township has been badly culled by shake makers. Agricultural claims have been entered in the heavy timber, the sugar pine fit for shakes cut off, and the entry abandoned. Great quantities of large sugar pine lie rotting on the ground—cut down, found to split hard, and rejected. Almost every sugar pine of any considerable size in the township is ax marked, to try its splitting qualities.

Forested and other areas in T. 35 S., R. 3 E., Oregon.

	Acres.
Forested area	20, 040
Nonforested area (glades and meadow, 1,500; burned, 1,500)	3, 000
Badly burned area	500
Logged area (the sugar pine culled 10 per cent)	12, 000

Total stand of timber in T. 35 S., R. 3 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	54. 8	125, 000, 000	160, 000, 000
Sugar pine	4. 4	10, 000, 000	11, 000, 000
Red fir	37. 3	85, 000, 000	109, 000, 000
White fir	2. 6	6, 000, 000	12, 000, 000
Incense cedar	. 9	2, 000, 000	3, 000, 000
Total		228, 000, 000	295, 000, 000

Composition of forest in T. 35 S., R. 3 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	70
Sugar pine	3
Red fir	20
White fir	5
Incense cedar	. 5
Oaks, etc	1. 5

TOWNSHIP 35 SOUTH, RANGE 4 EAST.

This township lies well over on the western slopes of the main range of the Cascades, owing to a curve in the crest line toward the east after leaving Mount Pitt.

The western portion of the township consists of a series of low, narrow terraces parallel to the crest of the range, each terrace appearing to mark the outer rim of successive lava flows. The central and eastern areas comprise bowlder-strewn slopes rising with an easy gradient toward the crest.

The drainage from the township is small in amount and is mostly contained in Clark Fork and Fourmile Creek, which head in the township. Eventually it finds its way into Rogue River through Big Butte Creek. The waters of the streams flowing from the township are used locally, in a small way, for irrigation purposes.

The township has been heavily forested. All the heavy stands have been burned in recent times; that is to say, since the advent of the white man. The southern boundary of the township marks the beginning of the immense burns, which stretch northward along the summit and the immediate western declivities of the main range for a distance of at least 40 miles. Throughout the central and western areas of the township and almost through the next one north, a distance of about 11 miles with a width of 5 miles, there is one solid burn, where scarcely a tree is to be seen outside of the swampy or wet slopes of a few of the larger canyons. It is the most thorough and complete sweep of a standing forest by fire that I have ever seen. The burned areas have become covered with brush composed of huckleberry, manzanita, garrya, service berry, and vellum-leaved ceanothus, the latter being the most abundant and conspicuous species.

No reforestations are visible, as yet, on these tracts. The western areas have suffered comparatively little from fire.

The forest is mostly of the yellow-pine type, small stands of red-fir type occur here and there, and thin lines of alpine-hemlock type follow the upper courses of some of the canyons which supply Clark Fork and Four Bit Creek. The stands of yellow-pine type are of considerable value and easy of access. They are found in the western portion of the township on the different terraces. The trees are remarkably thick set. Sometimes there are 80 trees per acre of logging size, a large number for stands of the yellow-pine type. Another remarkable feature of these stands is the short clear trunk and low stature of most of the trees. The greater number will not average much over 18 feet in clear trunk and 20 inches in diameter. These yellow-pine stands are much mixed with California black oak and Pacific post oak. I know of no place in this region where the oaks approach the crest line of the Cascades so closely in their range as in this township. In a straight line their farthest easterly station is not more than 8 miles from the summit.

All of the commercially valuable timber can easily be logged from the west via the Rancheria-Fort Klamath wagon road.

No mineral-bearing areas are known to occur in the township.

There is neither agricultural nor grazing land in the township. The forest floor in the yellow-pine stands is covered with a thin growth of grass, which is occasionally visited by bands of stock. Its value is unimportant.

Forested and other areas in T. 35 S., R. 4 E., Oregon.

	Acres.
Forested area	12,240
Nonforested area (chiefly burned)	10,800
Badly burned area	12,000
Logged area	None.

Total stand of timber in T. 35 S., R. 4 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	57.8	52,000,000	69,000,000
Red fir	27.7	25,000,000	42,000,000
White fir			2,750,000
Noble fir	11.1	10,000,000	15,000,000
Alpine hemlock	3.3	3,000,000	6,000,000
Total		90,000,000	134,750,000

Composition of forest in T. 35 S., R. 4 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	48
Sugar pine	Scattered trees.
White pine	Scattered trees.
Lodgepole pine	Scattered trees.
Red fir	30
White fir	1
Noble fir	14.5
Alpine hemlock	5
Oak	1.5

TOWNSHIP 35 SOUTH, RANGE 5 EAST.

This township is situated in part on the western slopes and in part on the eastern declivities of the Cascades, the crest line of the range passing through it from north to south, a little west of the center. The summit of the range consists of a plateau-like area having a mean elevation of 6,000 feet. A narrow, low ridge of lava along the western edge of the plateau forms the crest. A low ridge of lava stretches across from east to west, connecting the extinct volcanic cone, Lost Peak, with the volcanic areas along the crest. The plateau extends eastward and covers all of the eastern sections of the township. It has been extensively glaciated, and as a result low ridges consisting of blocks of lava are heaped up and surround shallow depressions which hold small lakelets, most of which have no visible outlet.

The western portion of the township consists of areas sloping into the canyon of South Fork of Rogue River, which heads near the southern line of the township. Near its head the stream lies mostly in a narrow, rocky valley, immense crags and cliffs forming the western wall of its canyon. The eastern side slopes back more gradually.

The headwaters of South Fork of Rogue River drain the western part of the township. The stream heads in a number of lakes, the largest of which is 1½ miles in length and 350 or 400 yards in width. These lakes are situated in the bottom of the canyon and are known as Blue Canyon lakes. Within the township the South Fork of Rogue River is a small rivulet; its canyon, while narrow, is entirely out of proportion to the small volume of water now flowing through it. As with many other streams in the region, the amount of water in its upper portions does not anywhere near account for the quantities which must be shed from the adjacent slopes. The southern areas of the eastern sections of the township drain into tributaries of Fourmile Creek, which empties into Pelican Bay. The northern portions have no definite visible drainage. The precipitation either sinks directly into fissures in the lava or accumulates in small lakelets which may possess underground outlets.

The township contains no agricultural lands. Marshy places around the edges of Blue Canyon lakes and the lakelets in the eastern areas of the township would supply small quantities of pasturage, but the tracts are all difficult of access.

The forest is of the alpine-hemlock type throughout. Fires of modern origin have ravaged it extensively. The great burns which cover the eastern areas of the adjoining township on the west extended into the western portion of this township and wrought great havoc among what must once have been heavy stands of noble fir. The forest in the eastern areas has suffered no less, and there are scant signs of reforestation. Most of the young growth now standing is overwhelmingly composed of lodgepole pine. The bottom and eastern slopes of the South Fork Canyon have escaped fairly well and carry a forest in a state of tolerably good preservation. Much of it has not experienced a fire for 300 or 400 years, and in consequence it contains a vast amount of litter, consisting chiefly of the original lodgepole-pine growth which followed a fire that occurred between three and four centuries ago. The lodgepole pine has had time to mature, die, and fall down, and a new forest 150 years old has taken its place since that time. The soil having had time to regain its normal moisture ratio, the last forest on this tract is not lodgepole pine, but is composed of Engelmann spruce, alpine hemlock, noble fir, and alpine fir.

The mill timber throughout the township is of poor quality, besides being composed of undesirable species from a lumberman's point of view. With the exception of the southern portion of the eastern areas, the timbered tracts in the township are practically inaccessible so far as logging operations are in question, or, in other words, 90 per cent of the forested area can not be logged.

No mineral-bearing ground has been discovered in the township.

Forested and other areas in T. 35 S., R. 5 E., Oregon.

	Acres.
Forested area	16,640
Nonforested area (chiefly burns)	6,400
Badly burned area	8,000
Logged area	None.

Total stand of timber in T. 35 S., R. 5 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Noble fir	29.2	7,000,000	14,000,000
White fir			6,450,000
Alpine hemlock	25	6,000,000	15,000,000
Engelmann spruce	45.8	11,000,000	17,000,000
Total		24,000,000	52,450,000

Composition of forest in T. 35 S., R. 5 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
White pine	Scattered trees.
Lodgepole pine	10
White fir	2
Noble fir	30
Alpine hemlock	30
Engelmann spruce	28

Township 35 South, Range 6 East.

This township is situated wholly on the eastern side of the main range of the Cascades and consists in part of the northern, eastern, and southern slopes of Lost Peak, an extinct volcanic cone situated in the western edge of the township and rising to a height of 8,000 feet above sea level, and in part in the eastern sections of marshy and swamp lands on the margins of Upper Klamath Lake. The mountainous portions of the township are uniformly rocky and barren at all of the higher elevations and throughout, at all altitudes, on the northern and western slopes of Lost Peak.

The visible water supply is in a few small springs and insignificant rivulets. The large precipitation which must fall on a mountain of the size and elevation of Lost Peak sinks in the crevices of its lava and is lost to view.

There are no agricultural lands in the township. The marshy areas in the eastern sections produce heavy growths of sedge and tule, but the lands are too wet and mucky to permit of their use for pasture or hay.

The forest consists of the three chief types common to the slopes of the Cascades in this region. The red fir and the yellow-pine types are not closely differentiated, the red and white fir components in the first-mentioned type forming more nearly subtype aggregations in the stands of yellow-pine type. The mill timber at the lowest and middle elevations on the southern and eastern slopes of Lost Peak is of fair quality and moderately easy of access, but is generally of small dimensions. Elsewhere and at high altitudes it is of poor quality and inaccessible.

Fires have marked nearly all of the forest throughout the township. Most of the damage has been on the northern and western slopes of Lost Peak. Reforestation is scanty, most of it being composed of scattered stands of lodgepole pine. Many of the burned-over tracts are covered with dense brush growth of various species of shrubs, the vellum-leaved ceanothus being the most common and prominent species.

None of the lands are mineral in character.

The areal and timber estimates are as follows:

Forested and other areas in T. 35 S., R. 6 E., Oregon.

	Acres.
Forested area	16, 740
Nonforested area (bare rocks and marsh 5,500; burned, 800)	6, 300
Badly burned area	5, 200
Logged area	None.

Total stand of timber in T. 35 S., R. 6 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M*
Yellow pine	44. 2	25, 000, 000	38, 000, 000
Sugar pine	3. 5	2, 000, 000	2, 650, 000
White pine	. 9	500, 000	500, 000
Red fir	17. 7	10, 000, 000	20, 000, 000
White fir	8. 9	5, 000, 000	30, 000, 000
Noble fir	17. 7	10, 000, 000	15, 000, 000
Alpine hemlock	7	4, 000, 000	6, 000, 000
Engelmann spruce			500, 000
Total		56, 500, 000	112, 650, 000

Composition of forest in T. 35 S., R. 6 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	20
Sugar pine	. 8
White pine	. 1
White-bark pine	. 01
Red fir	30
White fir	26
Noble fir	14
Alpine hemlock	7. 3
Engelmann spruce	1

TOWNSHIP 35 SOUTH, RANGE 7½ EAST.

This township is situated in Upper Klamath Lake and contains overflowed lands producing sedge and tule and lands deeply covered by the waters of the lake. It has no forested areas. In some places on the overflowed marshes semidry hummocks covered with willow brush are beginning to appear, which is evidence of a gradual lowering or drying up of the lake through natural causes.

TOWNSHIP 35 SOUTH, RANGE 7 EAST.

The western areas of this township consist of marshy and grass-covered tracts bordering Upper Klamath Lake. The eastern sections include steep ridges of volcanic origin rising abruptly from the marshy eastern areas.

The steep western front of the hilly section is sparsely timbered; the balance bears a forest of yellow pine of light stands and inferior quality. It is all fire marked.

Forested and other areas in T. 35 S., R. 7. E., Oregon.

	Acres.
Forested area	15,360
Nonforested area (marsh and meadow)	7,680
Logged area	None.

Total stand of timber in T. 35 S., R. 7 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	Feet B. M.	Feet B. M.
Yellow pine	100	25,000,000	40,320,000

Composition of forest in T. 35 S., R. 7 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	95
Lodgepole pine	5

TOWNSHIP 35 SOUTH, RANGE 8 EAST.

This township is situated east of the main range of the Cascades and consists of rough, broken ridges and slopes radiating from Swan Lake Point.

The forest is chiefly yellow pine of medium quality, fire marked throughout, and difficult of access. Small grassy swales occur and are fringed with stands of lodgepole pine.

Forested and other areas in T. 35 S., R. 8 E., Oregon.

	Acres.
Forested area	23,040
Logged area	None.

Total stand of timber in T. 35 S., R. 8 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	87	40,000,000	59,296,600
Sugar pine	4.3	2,000,000	2,764,800
Red fir	8.7	4,000,000	5,776,200
White fir			1,382,400
Total		46,000,000	69,220,000

Composition of forest in T. 35 S., R. 8 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	90
Sugar pine	1
Lodgepole pine	6
White fir	1
Red fir	2

TOWNSHIP 35 SOUTH, RANGE 9 EAST.

The northern portion of this township consists of flats and low hills of rough lava. It is sparsely or not at all timbered, the forest, when present, being composed of scattered trees of yellow pine, or of thin lines of yellow pine, lodgepole pine, cottonwoods, and aspen fringing the streams. The central and southern areas consist of slopes and spurs projecting from Saddle Mountain, a volcanic peak. These ridges are well timbered along their summits and intermediate slopes, sparsely at their base. The yellow pine, which forms the principal mill timber, is mostly of small growth, rarely exceeding 24 inches at the base; 60 per cent falling below 20 inches basal diameter. It is difficult of access except at the lowest elevations and is fire marked throughout.

Forested and other areas in T. 35 S., R. 9 E., Oregon.

	Acres.
Forested area	15,340
Nonforested area (grazing and semiarid)	7,700
Badly burned area	1,200
Logged area	None.

Total stand of timber in T. 35 S., R. 9 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	92.8	65,000,000	73,000,000
Sugar pine	5.7	4,000,000	1,000,000
Red fir	1.5	1,000,000	4,000,000
White fir			2,000,000
Total		70,000,000	80,000,000

Composition of forest in T. 35 S., R. 9 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	85
Lodgepole pine	12
Sugar pine	.25
Red fir	2
White fir	.75

Township 35 South, Range 10 East.

This township consists of a semiarid lava plateau bordering and extending north of the Sprague River Valley. In the extreme northern portion of the township the plateau rises into steep, rocky hills.

The region is very sparsely timbered, the forest consisting of scattered trees of low, scraggy growth.

Forested and other areas in T. 35 S., R. 10 E., Oregon.

	Acres.
Forested area	12,160
Nonforested area (meadow and semiarid grazing land)	10,880
Logged area	None.

Total stand of timber in T. 35 S., R. 10 E., Oregon.

Species.	Local practice.	Michigan practice.
	Feet B. M.	*Feet B. M.*
Yellow pine		6,000,000

Composition of forest in T. 35 S., R. 10 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	99
Lodgepole pine Western juniper	1

TOWNSHIP 35 SOUTH, RANGE 11 EAST.

This township comprises a rocky lava plateau stretching northward from the Sprague River Valley.

Light stands of yellow pine and western juniper are scattered over the plateau and along the intersecting shallow ravines.

Forested and other areas in T. 35 S., R. 11 E., Oregon.

	Acres.
Forested area	6,340
Nonforested area (meadow and semiarid grazing land)	16,700
Logged area	None.

Total stand of timber in T. 35 S., R. 11 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			3,200,000

Composition of forest in T. 35 S., R. 11 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	99
Western juniper	1
Cottonwood	
Aspen	

TOWNSHIP 35 SOUTH, RANGE 12 EAST.

This township consists chiefly of a stony lava plateau stretching northward from Sprague River Valley and bordering on the west the lower reaches of the Sycan River. The northeast corner contains a hilly area coming into the township from the Black Hills.

The plateau portion of the township is nearly treeless. The hilly areas bear light stands of yellow pine of inferior quality, fire marked, and more or less difficult of access.

Forested and other areas in T. 35 S., R. 12 E., Oregon.

	Acres.
Forested area	4,240
Nonforested area (meadow and semiarid grazing land)	18,800
Logged area (culled 50 per cent)	1,000

Total stand of timber in T. 35 S., R. 12 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	8,000,000	17,300,000

Composition of forest in T. 35 S., R. 12 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	99
White fir	1
Western juniper	
Lodgepole pine	
Cottonwood	
Aspen	

Township 35 South, Range 13 East.

The northwestern areas of this township consist of southward-projecting spurs from the Black Hills Range. The central and southern portions consist of broad slopes and low ridges which are intersected by many small streams fringed with grassy, nonforested glades. In the extreme southern area is a nucleus of rocky ledges around an extinct crater.

The central and northern areas are timbered with stands of yellow pine of moderate density and of medium quality. The southern sections are very thinly forested, and the stands are separated by large grassy or sagebrush-covered flats.

The region is easy of access.

Forested and other areas in T. 35 S., R. 13 E., Oregon.

	Acres.
Forested area	16, 940
Nonforested area (burned, 1,500; grazing, etc., 4,600)	6, 100
Badly burned area	2, 200
Logged area	None.

Total stand of timber in T. 35 S., R. 13 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	88. 3	40, 000, 000	48, 000, 000
Sugar pine	6. 6	3, 000, 000	3, 000, 000
White fir	4. 4	2, 000, 000	6, 000, 000
Incense cedar	. 6	300, 000	600, 000
Total		45, 300, 000	57, 600, 000

Composition of forest in T. 35 S., R. 13 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	90
Sugar pine	. 5
Lodgepole pine	8
White fir	1. 4
Incense cedar	. 1
Western juniper	

TOWNSHIP 35 SOUTH, RANGE 14 EAST.

This township was estimated from information, and was not examined personally.

Forested and other areas in T. 35 S., R. 14 E., Oregon.

	Acres.
Forested area	8,040
Nonforested area	15,000

Total stand of timber in T. 35 S., R. 14 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	16,000,000	22,000,000
White fir			6,000,000
Total		16,000,000	28,000,000

TOWNSHIP 36 SOUTH, RANGE 2 WEST.

This township consists chiefly of agricultural and grazing lands bordering Rogue River and its tributary, Bear Creek.

The timber occurs along the streams and on the slopes of Table Rock, where it is scattered in thin stands among masses of brush. It is of no commercial importance.

Forested and other areas in T. 36 S., R. 2 W., Oregon.

	Acres.
Forested area	4,200
Nonforested area	18,840

Total stand of timber in T. 36 S., R. 2 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			2,300,000
Red fir			200,000
Total			2,500,000

Composition of forest in T. 36 S., R. 2 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	30
Red fir	2
Oak	68

Township 36 South, Range 1 West.

The lands in this township are mostly level valley lands of the semiarid type, supporting a scant growth of grass, and utilized for agricultural purposes where water for irrigation is available.

The coniferous growth is confined to a few hilly areas in the southern sections. It has no commercial value. The region outside the cultivated areas is dotted with copses of low-growing oaks and numerous patches of the common chaparral of the region (*Ceanothus cuneatus*).

Forested and other areas in T. 36 S., R. 1 W., Oregon.

	Acres.
Forested area	5, 000
Nonforested area	18, 040
Logged area (culled, 90 per cent)	All.

Total stand of timber in T. 36 S., R. 1 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			2, 700, 000
Red fir			300, 000
Total			3, 000, 000

Composition of forest in T. 36 S., R. 1 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	58
Red fir	2
Oak	40

Township 36 South, Range 1 East.

The township consists of low hills and level areas along Little Butte and Antelope creeks. The tracts are all of the semiarid type, and are under cultivation where irrigation is possible and practicable.

Fires have run throughout the township, and large areas of the slopes are covered with dense stands of mountain mahogany and other varieties of scrub vegetation.

The mill timber has long ago been closely culled and what is left is of little commercial value.

Forested and other areas in T. 36 S., R. 1 E., Oregon.

	Acres.
Forested area	9, 400
Nonforested area	13, 640
Logged area (culled, 75 per cent)	All.

Total stand of timber in T. 36 S., R. 1 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			4,800,000
Red fir			500,000
Total			5,300,000

Composition of forest in T. 36 S., R. 1 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	70
Red fir	5
White fir	Scattered trees.
Oak	25
Madrona	Scattered trees.

TOWNSHIP 36 SOUTH, RANGE 2 EAST.

This township comprises a hilly region, with many steep and rocky ridges draining into the tributaries of Little Butte Creek.

The forest is scanty and mostly of inferior quality, the best portions having long since been cut out.

Fires have marked it all, and have induced extensive brush growths throughout the timbered areas.

Forested and other areas in T. 36 S., R. 2 E., Oregon.

	Acres.
Forested area	16,040
Nonforested area	7,000
Logged area (culled, 30 per cent)	10,000

Total stand of timber in T. 36 S., R. 2 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	35.7	5,000,000	12,000,000
Sugar pine	7.1	1,000,000	3,000,000
Red fir	57.1	8,000,000	22,000,000
White fir			3,000,000
Incense cedar			1,000,000
Total		14,000,000	41,000,000

Composition of forest in T. 36 S., R. 2 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	35
Sugar pine	1
Red fir	50
White fir	8
Incense cedar	.2
Oak	5.8

TOWNSHIP 36 SOUTH, RANGE 3 EAST.

This township is situated in part within the watershed of Little Butte Creek and in part within the watershed of the South Fork of Big Butte Creek. The eastern areas consist of long, easy slopes stretching westward from the base of Mount Pitt; the western portions are a mass of steep, broken ridges and slopes with broad valleys in the north-central areas of the township.

The central and, in part, the eastern areas contain a very massive forest in which the yellow pine, largely composed of standards and veterans, is of excellent quality and easy of access. A large proportion of the red fir is composed of small standards. The noble fir enters the township in the extreme eastern areas. The white pine occurs in the southeast areas. Fires have run through most of the township, burning 10 per cent of the timber. Brush growths with scanty reforestations are the results of the fires.

Forested and other areas in T. 36 S., R. 3 E., Oregon.

	Acres.
Forested area	19,440
Nonforested area (meadows, glades, etc.)	3,600
Badly burned area	1,500
Logged area	600

Total stand of timber in T. 36 S., R. 3 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	22.4	35,000,000	50,000,000
Sugar pine	1.3	2,000,000	4,500,000
White pine	3.2	5,000,000	6,000,000
Red fir	64.1	100,000,000	160,000,000
White fir	3.2	5,000,000	25,000,000
Noble fir	5.2	8,000,000	10,500,000
Incense cedar	.6	1,000,000	2,500,000
Total		156,000,000	258,500,000

A. MOUNT PITT, FROM WEST END OF PELICAN BAY, UPPER KLAMATH LAKE.

B. MOUNT PITT, AS SEEN FROM FISH LAKE.

Composition of forest in T. 36 S., R. 3 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent
Yellow pine	23
Sugar pine	.5
White pine	.5
Lodgepole pine	2
Red fir	60
White fir	10
Noble fir	3
Incense cedar	.2
Yew and cottonwood	.8

TOWNSHIP 36 SOUTH, RANGE 4 EAST.

This township in part is situated on the western slope of the Cascades. In part it covers the summit, while the extreme eastern sections lie on the eastern declivities of the range. The crest line of the Cascades enters the township near the northeast corner, forming a west-curving arch toward the southeast corner, where it leaves the township. The western areas of the township consist of a series of narrow, flat terraces encircling the base of Mount Pitt. The central and eastern sections contain Mount Pitt in the northern portions and have the southern and intermediate areas filled with vast lava flows from the volcanic vents which anciently existed around this peak.

Mount Pitt, seen from any direction, appears as a huge, symmetrical, sharp-pointed cone. In reality it is a narrow hogback which originally formed the western and southern segments of the periphery of a huge crater. Most of this crater has been blown away by ancient eruptions, leaving standing the sharp-crested ridge now known as Mount Pitt. At the northwestern termination the ridge falls sharply and precipitously away, which, together with the steep slopes on all sides, give it the characteristic conical aspect. The mountain has an altitude of 9,760 feet. It stands on a nearly circular platform of lava about 6 miles in diameter. A great deal of this lava is of the most vesicular type and is indescribably rough. It has issued from fissures at the base of the mountain and is of comparatively recent formation, much of it not having the slightest soil covering, or supporting any vegetation except mosses and lichens in the crevices (Pl. LXXXIII, *A* and *B*).

The crest line of the Cascades passes directly through the mountain and continues southward to Mount Brown, being formed, in part, between the two peaks of a rough lava flow which apparently welled out from a fissure that opened southward from Mount Pitt, and, in part, from lava flows ejected northward from Mount Brown.

With the exception of a few unimportant rivulets the entire visible drainage of the township is concentrated in the North Fork of Little Butte Creek. This stream and its water supply is of some importance, inasmuch as it is drawn upon for a large portion of the irrigation water utilized on the semiarid tracts in the region of Eagle Point and Brownsboro in the Rogue River Valley. The stream first issues from under a mass of rough, heaped-up lava which forms the crest of the Cascades between Mounts Pitt and Brown. It does not come forth as small springs, but flows out in a sheet 40 or 50 feet wide and 3 to 4 feet in depth, with a strong, steady current of ice-cold water. Immediately after issuing from under the lava it enters a sort of reservoir named Fish Lake, which in reality is only a widening of the stream. The lake is about a mile in length, one-third of a mile in width, and 4 to 5 feet in depth. The creek leaves the lake at the west end through a gap one-fourth of a mile in width, which soon narrows to 150 yards. It is cut through a mass of lava and is 50 to 60 feet in depth. Fish Lake is excellently situated for water-storage purposes.

There are no agricultural lands in the township. On the south side and at the west end Fish Lake is bordered by 200 to 250 acres of marshy meadow land, partly dry during a portion of each year, overflowed at high water, and covered with a coarse growth of tough and wiry sedge.

Cattle range through the forest, and both cattle and horses are occasionally driven to the marshy ground around the lake for summer pasture. In past years sheep were pastured at the lake, but none have been there in recent years.

All of the forest types occurring on the western slopes of the Cascades in the Rogue River Basin are represented in the township, but of the yellow-pine type there is but a small quantity. Most of the township is covered with stands of the red-fir type. The alpine-hemlock type occurs on the slopes of Mount Pitt and on the adjacent high-altitude areas. The summit of Pitt projects about 350 feet above the timber line on the southern declivities and 800 feet above the line on the northern slopes.

Forest fires have ravaged all of the timbered tracts, consuming an enormous quantity of mill timber, if one may judge from the density of a few of the surviving veteran stands on the northern side of Fish Lake, which in some localities will cut 90,000 feet B. M. per acre. Especially have the fires been severe in the timbered tracts below the Mount Pitt platform to the west of the mountain. In almost every case the burned-over areas have grown up to brush, with scant signs of reforestation. In the burns a mile or two north of Fish Lake fires of recent origin have burned out even the soil down to the rough lava foundation. This has been possible because the soil on the younger lava flows, when there is any at all, is wholly composed of decaying woody matter.

The timber is of fair quality in the southwestern and west-central areas, but elsewhere is much damaged by rot due to fire scars and scars. It can be logged on all areas below subalpine elevations by way of the old Rancheria-Fort Klamath wagon road, which runs through the center of the next township north, and, over a road with easy gradients, which affords an outlet to the Rogue River Valley settlements.

Forested and other areas in T. 36 S., R. 4 E., Oregon.

	Acres.
Forested area	16,040
Nonforested area (naturally nonforested, 4,500; burned, 2,500)	7,000
Logged area	None.

Total stand of timber in T. 36 S., R 4 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	3.1	5,000,000	10,000,000
Sugar pine	1.3	2,000,000	2,000,000
White pine	3.7	6,000,000	8,500,000
Red fir	75	120,000,000	148,000,000
Noble fir	11.9	19,000,000	37,000,000
White fir	5	8,000,000	27,000,000
Alpine hemlock			13,000,000
Western hemlock			1,500,000
Engelmann spruce			1,000,000
Total		160,000,000	248,000,000

Composition of forest in T. 36 S., R. 4 E., Oregon, including trees of all species with diameters of 4 inches at the base and upward.

	Per cent.
Yellow pine	5
Sugar pine	.25
White pine	2
White-bark pine	.001
Lodgepole pine	1
Red fir	60
White fir	14
Noble fir	10
Alpine fir	.001
Alpine hemlock	7
Western hemlock	.7
Engelmann spruce	.3

TOWNSHIP 36 SOUTH, RANGE 5 EAST.

This township is situated wholly on the eastern slope of the Cascades. The western areas consist of high, rough lava flows ejected partly from Mount Pitt, partly from Mount Brown; the central portions consist of glaciated lava flows with numerous depressions holding small lake and marshes, while the eastern sections are flat and marshy with intersecting low combs and ridges of volcanic rock.

The drainage of the township flows into Pelican Bay of Upper Klamath Lake through a number of small creeks heading near Mount Pitt, and mostly dry in the summer time. In the north-central regions of the township is Fourmile Lake, 2½ miles in length by one-half or three-fourths mile in width. East and south of the lake there are a dozen or more shallow lakelets scattered about in the depressions existing in the lava sheet along the northeast foot of Mount Pitt. The paucity of visible drainage from this and the foregoing townships, and in general from the entire region of high and middle altitude in the Cascades south of township 34, is noteworthy. Evidently most of the water sinks in the lava, which must be widely fissured. It is not clear where it again comes to the surface. Possibly the large and numerous springs rising in the bottom of Pelican Bay in Upper Klamath Lake account for some, but most of it is lost, or at least does not come to the surface anywhere in the immediate region of the Cascades.

There are no agricultural lands in the township. Nearly all of the creeks in the central and eastern portions are bordered by marshy sedge meadows which could be utilized for pasturage.

The forest is chiefly of the red-fir type. Areas near Mount Pitt carry stands of alpine-hemlock type and tracts in the eastern sections contain small quantities of yellow-pine type.

Forest fires have ravaged the township everywhere. Recurrent fires in the central and eastern areas have laid waste large tracts of lodgepole-pine reforestations after earlier fires. In the western portions heavy stands of veteran noble fir have been destroyed, leaving behind only lone trees here and there. The reforestations have been confined mostly to low-lying areas with plenty of seepage and soil moisture. On the slopes, brush growths have replaced the forest in almost every instance. Altogether 40 per cent of the standing timber has been destroyed by fire within the last forty or forty-five years, and at least 50 per cent of the ensuing reforestations of lodgepole pine. The old military road between Fort Klamath and the Rogue River Valley passed through the center of the township in an east–west direction. The travel over this road was, doubtless, responsible for many of the devastating fires which have demolished its forests.

The quality of the timber is poor, owing to the frequent fires. The white pine occurs chiefly in the south-central portions of the township. It is of small growth, seldom exceeding 20 inches basal diameter and 30 feet clear trunk. The township can be logged from the Pelican Bay region, but none of its areas are readily accessible.

No mineral deposits are known to occur in the township.

Forested and other areas in T. 35 S., R. 5 E., Oregon.

	Acres.
Forested area	12, 840
Nonforested area (meadows, etc., 5,000, burned clean, 5,200)	10, 200
Badly burned area	12, 000
Logged area	None.

Total stand of timber in T. 36 S., R. 5 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	5. 3	3, 000, 000	3, 000, 000
White pine	14.	8, 000, 000	12, 000, 000
Red fir	35.	20, 000, 000	36, 000, 000
White fir	17. 6	10, 000, 000	60, 700, 000
Noble fir	17. 6	10, 000, 000	13, 000, 000
Alpine hemlock	8. 8	5, 000, 000	10, 000, 000
Western hemlock			2, 000, 000
Engelmann spruce	1. 7	1, 000, 000	3, 000, 000
Total		57, 000, 000	139, 700, 000

Composition of forest in T. 36 S., R. 5. E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	2
White pine	8
Lodgepole pine	8
Red fir	20
White fir	45
Noble fir	10
Alpine hemlock	5
Western hemlock	1
Engelmann spruce	1

TOWNSHIP 36 SOUTH, RANGE 6 EAST.

This township is situated wholly east of the Cascades, and comprises in the western and southern areas low rocky terminations of the volcanic mountain masses of the adjacent townships on the south and west. The central portions consist of low marshy flats, extending eastward and connecting with marshy tracts bordering Pelican Bay, which, together with a small portion of the bay, cover the eastern sections of the township.

Almost the entire visible water supply flows into Fourmile Creek, through which it finds its way into Pelican Bay. Exception should be made in the case of the large and numerous springs which rise in the bottom of that bay, and whose origin undoubtedly is in the mountains in the western portion of the township. The volume of water in Fourmile Creek is small until about 2 miles above its outlet, where it is suddenly augmented.

The lands which can be utilized for purposes of agriculture comprise 2,000 acres; the grazing lands about 2,000 more. The tracts of grazing and agricultural lands are situated along Fourmile Creek, in the central areas of the township, extending westward about 3 miles from the marshy areas bordering Pelican Bay, and in the southeastern sections of the township bordering the bay. With few exceptions they are wet and liable to overflow, but are capable of yielding large quantities of coarse wild hay. The marshy areas bordering Pelican Bay are very wet and muddy, and can be pastured only in late summer and fall. Almost all of the grazing and agricultural land is held by residents or nonresident private owners. Some of the land here classed as agricultural is covered with half-burned growths of lodgepole pine, requiring clearing. The grazing lands are naturally nonforested, and must so remain, owing to their wet and swampy nature. Lying directly in the track of the draftage from the permanently snow-covered northeastern slopes of Pitt, the region is frosty, or at least liable to summer frosts. It is doubtless for this reason that no agricultural improvements of much value or permanency have been made.

The forest is wholly of yellow-pine type. Fires have ravaged it in all directions, and have been followed by lodgepole-pine reforestations on low-lying areas, and by brush growths on the higher and drier. The best timber is found on the southern slopes of Lost Peak, in the north-central areas of the township, along the bottoms of Fourmile Creek, on tracts elevated sufficiently to be permanently above high water, where occur heavy and very valuable stands of nearly pure growth yellow pine, and in the southeastern sections of the township, where the forest is thickest, but the timber of inferior quality.

The township can easily be logged from Pelican Bay. The logging so far done consists of cuttings to supply local demands of settlers, and has been carried on for many years. The cutting in the extreme southeast corner of the township has been for export to the mills at the foot of Upper Klamath Lake.

No mineral-bearing areas have been discovered in the township.

Forested and other areas in T. 36 S., R. 6 E., Oregon.

	Acres.
Forested area	15,840
Nonforested area (meadows, marsh, etc.)	7,200
Badly burned	5,500
Logged area (98 per cent then burned over)	2,000

Total stand of timber in T. 36 S., R. 6 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	73.7	95,000,000	110,000,000
Sugar pine	6.2	8,000,000	8,300,000
Red fir	19.3	25,000,000	35,000,000
White fir			20,000,000
Incense cedar	.8	1,000,000	2,100,000
Total		129,000,000	175,400,000

Composition of forest in T. 36 S., R. 6 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	40
Sugar pine	1
Lodgepole pine	20
Red fir	20
White fir	18
Incense cedar	1

TOWNSHIP 36 SOUTH, RANGE 7A EAST.

This township comprises areas mostly covered by the waters of Upper Klamath Lake.

A few of the points projecting into the lake bear a light forest of little or no commercial value.

Forested and other areas in T. 36 S., R. 7a E., Oregon.

	Acres.
Forested area	3,000
Nonforested area (marshes and lake)	20,040
Logged area	None.

Total stand of timber in T. 36 S., R. 7a E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			2,500,000
Red fir			500,000
Total			3,000,000

Composition of forest in T. 36 S., R. 7a E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	80
Lodgepole pine	10
Red fir	10

Township 36 South, Range 7b East.

This township is mostly covered by the waters of Upper Klamath Lake, or comprises lands intermittently overflowed from that source.

The northeastern portions of the township are formed by a projecting point of the lava plateau which stretches northward from Swan Lake Point. The front of this plateau, where it breaks off to the lake, is of semiarid character, and is either bare or in spots covered with clumps of mountain mahogany or scrubby western juniper. The summit bears thin stands of yellow pine of inferior quality, mixed with small quantities of red fir and western juniper.

Forested and other areas in T. 36 S., R. 7b E., Oregon.

	Acres.
Forested area	7,280
Nonforested area	15,760
Logged area	None.

Total stand of timber in T. 36 S., R. 7b E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	15,000,000	21,640,000

Township 36 South, Range 8 East.

This township consists of a mass of broken ridges and spurs radiating from Swan Lake Point.

The ridges are timbered with a forest of yellow pine, most of which is of small dimensions and difficult of access. Grassy glades occur here and there among the ridges and are fringed with thin stands of lodgepole pine.

Forested and other areas in T. 36 S., R. 8 E., Oregon.

	Acres.
Forested area	23,040
Logged area	None.

Total stand of timber in T. 36 S., R. 8 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	92.3	36,000,000	72,000,000
Sugar pine	2.6	1,000,000	2,000,000
Red fir	5.1	2,000,000	4,000.000
White fir			5,000,000
Incense cedar			1,280,000
Total		39,000,000	84,280,000

Composition of forest in T. 36 S., R. 8 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	83
Sugar pine	.2
Lodgepole pine	12
Red fir	1
White fir	3
Incense cedar	.8
Western juniper	

TOWNSHIP 36 SOUTH, RANGE 9 EAST.

This township consists chiefly of steep slopes extending in an easterly direction from Swan Lake Point.

The region is well timbered except in the northeast corner of the township, where the stands are thin and are much broken by grassy glades. The timber is of medium quality, the yellow pine being largely composed of standards. It is fire marked throughout.

Forested and other areas in T. 36 S., R. 9 E., Oregon.

	Acres.
Forested area	21,840
Nonforested area	1,200
Badly burned area	3,300
Logged area	None.

Total stand of timber in T. 36 S., R. 9 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	88	95,000,000	110,500,000
Sugar pine	.9	1,000,000	1,300,000
Red fir	7.3	8,000,000	12,200,000
White fir	1.9	2,000,000	9,500,000
Incense cedar	1.9	2,000,000	2,500,000
Total	....	108,000,000	136,000,000

Composition of forest in T. 36 S., R. 9 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	88
Sugar pine	.3
Lodgepole pine	4.7
Red fir	3
White fir	4
Incense cedar	

Township 36 South, Range 10 East.

The northern sections of this township consist of bottom lands, mostly grass covered, bordering Sprague River, with small areas of steep lava bluffs north of the stream. The central and southern portions are hilly, and bear an open growth of yellow pine of small dimensions, mixed with small quantities of white fir and incense cedar along the higher elevations. The timbered areas are intersected by deforested tracts, which consist, in part, of grassy glades, wet in the springtime, dry during the balance of the year; in part, of stony tracts, with scattered junipers or growths of sagebrush.

The logging and culling has been done by the Klamath Indians.

Forested and other areas in T. 36 S., R. 10 E., Oregon.

	Acres.
Forested area	10, 240
Nonforested area	12, 800
Logged area (culled, 2 per cent)	Throughout.

Total stand of timber in T. 36 S., R. 10 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	30, 000, 000	38, 000, 000
White fir			2, 000, 000
Incense cedar			500, 000
Total		30, 000, 000	40, 500, 000

Composition of forest in T. 36 S., R. 10 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	99
Lodgepole pine White fir Incense cedar	1

Township 36 South, Range 11 East.

This township consists chiefly of agricultural and grazing areas bordering Sprague River. The southern portion of the township comprises a hilly area, which, in part, forms the divide between the Sprague River and the Lost River drainage. The lower slopes of this divide bear an open growth of yellow pine of fair quality, mixed with thin stands of western juniper. The higher and intermediate slopes bear a denser growth of yellow pine, mixed with a small percentage of white fir and incense cedar.

These stands of timber supply the Indians around the Yainax subagency with their timber and lumber.

Forested and other areas in T. 36 S., R. 11 E., Oregon.

	Acres.
Forested area	7,680
Nonforested area	15,360
Logged area (culled on an average 10 per cent)	4,500

Total stand of timber in T. 36 S., R. 11 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	Feet B. M.	Feet B. M.
Yellow pine	100	58,000,000	64,000,000
White fir			2,200,000
Incense cedar			300,000
Total		58,000,000	66,500,000

Composition of forest in T. 36 S., R. 11 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	99
White fir Incense cedar Western juniper	1

TOWNSHIP 36 SOUTH, RANGE 12 EAST.

The northern areas of this township consist of grazing and agricultural lands bordering Sprague River. The central and most of the southern areas comprise a rocky lava plateau, carrying light and scattering stands of yellow pine and western juniper. In the extreme southern portions are a few slopes belonging to the Sprague River–Lost River divide, which carry stands of yellow pine of medium density and quality.

Forested and other areas in T. 36 S., R. 12 E., Oregon.

	Acres.
Forested area	2,500
Nonforested area (grass or semiarid tracts)	20,540
Logged area	None.

Total stand of timber in T. 36 S., R. 12 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	Feet B. M.	Feet B. M.
Yellow pine			2,500,000
White fir			300,000
Total			2,800,000

Composition of forest in T. 36 S., R. 12 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	99
White fir Incense cedar Western juniper	1

Township 36 South, Range 13 East.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 36 S., R. 13 E., Oregon.

	Acres.
Forested area	16,040
Nonforested area	7,000
Logged area	None.

Total stand of timber in T. 36 S., R. 13 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	100,000,000	113,000,000

Township 36 South, Range 14 East.

This township was not personally examined, but estimated from information.

Forested and other areas in T. 36 S., R. 14 E., Oregon.

	Acres.
Forested area	8,040
Nonforested area	15,000

Total stand of timber in T. 36 S., R. 14 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	5,000,000	8,000,000

Township 37 South, Range 2 West.

This township comprises chiefly farming land in the Rogue River Valley. The timbered portions are confined to a low hilly region in the western sections. The timber is small and worthless for mill purposes.

Forested and other areas in T. 37 S., R. 2 W., Oregon.

	Acres.
Forested area	2,400
Nonforested area	20,640
Logged area	All.

Total stand of timber in T. 37 S., R. 2 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			800,000
Red fir			400,000
Total			1,200,000

Composition of forest in T. 37 S., R. 2 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	65
Red fir	30
White fir, incense cedar, oak, etc	5

TOWNSHIP 37 SOUTH, RANGE 1 WEST.

The western and central portions of this township comprise agricultural and grazing lands of various character. The agricultural lands are in Bear Creek Valley and grazing lands on the slopes of Grizzly Range. These lands carry in some places oak copses and scattered trees of yellow pine.

The summit of the range and the eastern slope are timbered with light stands of yellow pine and red fir, mostly of small growth. The forest is much intersected with grassy glades, all badly overpastured.

Forested and other areas in T. 37 S., R. 1 W., Oregon.

	Acres.
Forested area	9,540
Nonforested area (meadows, agricultural, and rocky glades)	13,500
Logged area	3,600

Total stand of timber in T. 37 S., R. 1 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	37.5	6,000,000	9,000,000
Sugar pine			1,000,000
Red fir	62.5	10,000,000	15,000,000
White fir			5,000,000
Incense cedar			400,000
Total		16,000,000	30,400,000

Composition of forest in T. 37 S., R. 1 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	32
Sugar pine	Scattered trees.
Red fir	50
White fir	14
Oak	4
Incense cedar	Scattered trees.

TOWNSHIP 37 SOUTH, RANGE 1 EAST.

This township consists of eastern slopes of the Grizzly Range and a broken and hilly region forming portions of Antelope and Little Butte creeks watershed.

The forest is much scattered, forming thin stands surrounded with broad strips of brush growth throughout the township. It is of small growth and mostly of inferior quality.

Forested and other areas in T. 37 S., R. 1 E., Oregon.

	Acres.
Forested area	21,140
Nonforested area (glades, etc.)	1,900
Badly burned area	2,300
Logged area	Throughout to the extent of 35 per cent.

Total stand of timber in T. 37 S., R. 1 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	62.5	10,000,000	18,000,000
Sugar pine			500,000
Red fir	37.5	6,000,000	12,000,000
White fir			1,500,000
Total		16,000,000	32,000,000

Composition of forest in T. 37 S., R. 1 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	35
Sugar pine	Scattered trees.
Red fir	50
White fir	5
Oak	10

TOWNSHIP 37 SOUTH, RANGE 2 EAST.

This township comprises a much broken region in the watershed of Little Butte Creek. The northern areas are lightly timbered; the southern bear good stands of forest. Red fir of small growth is the principal component.

Forested and other areas in T. 37 S., R. 2 E., Oregon.

	Acres.
Forested area	20,040
Nonforested area (naturally nonforested)	3,000
Badly burned area	2,600
Logged area	800

Total stand of timber in T. 37 S., R. 2 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent	*Feet B. M.*	*Feet B. M.*
Yellow pine	28.5	20,000,000	35,000,000
Sugar pine			1,700,000
Red fir	71.5	50,000,000	60,000,000
White fir			4,000,000
Total		70,000,000	100,700,000

Composition of forest in T. 37 S., R. 2 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	35
Sugar pine	2
Red fir	58
White fir	5

Township 37 South, Range 3 East.

The township consists chiefly of steep, rocky areas at the headwaters of Little Butte Creek. The forest is of medium density, and is intersected by great numbers of small rocky glades.

Forested and other areas in T. 37 S., R. 3 E., Oregon.

	Acres.
Forested area	19,540
Nonforested area (rocky glades and agricultural)	3,500
Badly burned area	800
Logged area (culled 25 per cent)	1,500

Total stand of timber in T. 37 S., R. 3 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	27	38,000,000	54,000,000
Sugar pine	3.5	5,000,000	5,600,000
Red fir	68	95,000,000	130,000,000
White fir	1.4	2,000,000	4,000,000
Total		140,000,000	193,600,000

Composition of forest in T. 37 S., R. 3 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	35
Sugar pine	3
Red fir	56
White fir	5
Incense cedar Pacific yew	1

TOWNSHIP 37 SOUTH, RANGE 4 EAST.

This township forms the southwest corner of the reserve and is situated wholly on the western declivities of the Cascades. It consists of rough and rocky areas, the eastern sections covered with lava flows from an extinct cone in the township to the east, locally known as Mount Brown. Most of these lava flows are of comparatively recent origin, so much so that no soil has as yet covered them.

The forest is of red-fir type, light and irregular in the eastern half of the township, but comprising some exceedingly heavy stands in the western areas.

The township contains no agricultural lands, but along North Fork of Little Butte Creek, which drains the western half of the township, are narrow swales of grazing lands, marshy or merely wet during stages of low water, submerged during flood seasons. Cattle range throughout the township, and considerable tracts of forest have been burned within recent years, apparently to provide browse for the stock. There are no signs to indicate that sheep have been pastured in the township in recent years.

In the aggregate there are only 1,000 or 1,500 acres in the township not touched by fires of modern origin. These tracts exist as small, detached spots, everywhere surrounded by a network of fire lanes, where the destruction varies from 10 per cent to total.

The density of the forest varies much. On the lava flows from Mount Brown it is less than 2,000 feet B. M. per acre. In the western sections of the township the best stands average 17,000 feet B. M. per acre, while small areas here and there in the same sections run as high as 80,000 feet B. M. per acre.

With the exception of the lava tracts in the eastern portions of the township, which are wholly inaccessible, the timbered areas can be logged from the south by way of the Ashland-Pelican Bay wagon road.

No mineral deposits are known to exist in the township.

Forested and other areas in T. 37 S., R. 4 E., Oregon.

	Acres.
Forested area	18,940
Nonforested area (bare rocks, meadows, glades, etc., 3,100; burned clean 1,000)	4,100
Badly burned area	4,500
Logged area	None.

Total stand of timber in T. 37 S., R. 4 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
White pine	8.2	13,000,000	18,000,000
Red fir	69.2	110,000,000	180,000,000
White fir	12.5	20,000,000	48,500,000
Noble fir	9.4	15,000,000	26,000,000
Engelmann spruce	.6	1,000,000	3,500,000
Yellow pine			940,000
Total		159,000,000	276,940,000

Composition of forest in T. 37 S., R. 4 E., Oregon, including trees of all species with diameters of 4 inches and upward.

	Per cent.
Yellow pine	.2
White pine	6.
Sugar pine	Scattered trees.
Lodgepole pine	.8
Red fir	64.
White fir	18.
Noble fir	10.
Engelmann spruce	.8

Township 37 South, Range 5 East.

The western portion of this township consists of the crest-line areas of the main range of the Cascades; the central of a depression stretching from north to south with a width of 2 to 3 miles, and the eastern of the western slopes of a high, rugged, volcanic mountain mass lying between the Cascades and Upper Klamath Lake.

In the northwest corner of the township the crest of the Cascades is formed of an extinct volcanic cone locally known as Mount Brown. Lines of comparatively recent lava flows ejected from this vent constitute the crest for some miles south from this cone. Near the southwest corner of the township the lava flows come to an end and the summit of the range is a flat or gently rolling area 2 to 2½ miles in width.

Most of the central depression in the township is covered with the waters of Lake of the Woods. This is a shallow sheet of water, 3 miles long, about a mile in width at its widest portion. Its western shore line, formed by lava flows from Mount Brown, rises rocky and abrupt; its eastern shores are marshy for a short distance back from the lake, then rise gently toward the east in a succession of terraces.

Considering that the township lies within a region of comparatively heavy precipitation, its visible run-off is remarkably small. Evidently most of the water sinks in the much-fissured lava to reappear somewhere outside the township boundaries. The Lake of the Woods, which forms a sort of reservoir for the entire visible drainage of the township, empties into Upper Klamath Lake through an insignificant creek, which is dry throughout most of the year. It is not unlikely that the lake has an underground outlet.

The township contains no agricultural lands. The northern and the southern ends of Lake of the Woods terminate in marshes containing in the aggregate about 1,200 acres. They produce heavy growths of coarse marsh sedges and species of rush, and are covered with water to a depth of 2 to 4 feet during portions of the year.

The forest is chiefly of the red-fir type. It contains a small percentage of yellow pine, which species here crosses the Cascades, one line coming north from the yellow-pine areas in the Klamath Gap, another coming from the southwest through low gaps in the crest line of the range from the headwaters of Jenny and Dead Indian creeks. The red and white firs also cross the range in this township.

Fires have ravaged the entire township. With the exception of the thinly forested lava flows on the slopes of Mount Brown, I did not see a patch of forest as large as 20 acres which did not show the marks of fire within the past forty years. In many localities the fires have made a clean sweep of the timber, and the areas have grown up to brush; in other places they have been of low intensity, burning 40 per cent of a stand here, 5 per cent there, or merely destroying individual trees, but consuming the humus and killing the undergrowth. The areas to the west and at the south end of Lake of the Woods have been exceptionally badly damaged by recent fires. The entire township seems to have been peculiarly exposed to destructive forest fires for ages. Most of its forest consists of reforestations less than 120 years of age, which in some places contain scattered trees of veteran red fir 400 or more years old. One of the noteworthy features of the reforestations is the very large quantity of white fir in their composition.

Most of the timber in the township can be logged from the eastern side of the range via the Ashland-Pelican Bay wagon road. The areas around Mount Brown are inaccessible, so far as logging operations are in question. The timber is generally of inferior quality throughout, having been too often exposed to forest fires.

No mineral deposits are known to occur in the township.

Forested and other areas in T. 37 S., R. 5 E., Oregon.

	Acres.
Forested area	16,640
Nonforested area (lakes and marshes, 4,000; burned clean, 2,400)	6,400
Badly burned area	7,000
Logged area	None.

Total stand of timber in T. 37 S., R. 5 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	3.9	2,000,000	2,000,000
White pine	11.6	6,000,000	12,000,000
Red fir	39.	20,000,000	30,000,000
White fir	19.4	10,000,000	120,000,000
Noble fir	23.2	12,000,000	16,000,000
Alpine hemlock	2.9	1,500,000	3,000,000
Western hemlock			2,500,000
Engelmann spruce			400,000
Total		51,500,000	185,900,000

Composition of forest in T. 37 S., R. 5 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	1
White pine	5
Lodgepole pine	3
Red fir	15
Noble fir	8
White fir	64
Engelmann spruce	Scattered trees.
Alpine hemlock	2
Western hemlock	2

TOWNSHIP 37 SOUTH, RANGE 6 EAST.

This township constitutes the southwest corner of the reserve and is situated east of the main range of the Cascades. Almost the entire township is filled with the mass of a high, craggy mountain range of volcanic origin, connecting with the Cascades through a level plateau area in the northern portion of T. 38 S., R. 5 E.

The township has no agricultural or grazing lands. There are small grassy glades scattered throughout the mountain areas, but they are practically inaccessible.

The forest is a mixture of yellow-pine, red-fir, and alpine-hemlock types. On the eastern and northern slopes there are small tracts at the lowest elevations carrying stands of forest in which yellow pine predominates. At higher elevations occurs the red-fir type, while the great body of the mountain mass bears only stands of alpine-hemlock type of low, scraggy growth scattered among rocky peaks and canyons or on lava slopes where large, bare areas separate the thin lines and groups of trees.

Fires have run throughout the entire township, consuming 25 per cent of the timber and badly damaging the remainder. Brush growths composed chiefly of the vellum-leaved ceanothus (*Ceanothus velutinus*) have covered the burned areas in place of reforestations. The southeastern sections especially have suffered severely.

Most of the drainage of the township sinks through the fissured lava rocks and is lost. The superficial flow is small and inconsequential.

Small portions of the northern and eastern areas can be logged from the levels bordering Upper Klamath Lake, but the forest in the larger portion of the township can not be reached.

Forested and other areas in T. 37 S., R. 6 E., Oregon.

	Acres.
Forested area	14,040
Nonforested area (bare rocks, etc., 5,000; burned clean, 4,000)	9,000
Badly burned area	6,000
Logged area	None.

Total stand of timber in T. 37 S., R. 6 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	12.6	7,000,000	11,000,000
Sugar pine	1.8	1,000,000	1,000,000
White pine	.9	500,000	800,000
Red fir	7.2	4,000,000	4,000,000
White fir	18	10,000,000	40,000,000
Noble fir	39.9	22,000,000	33,000,000
Alpine hemlock	14.4	8,000,000	15,000,000
Engelmann spruce	5.4	3,000,000	6,000,000
Total	....	55,500,000	110,800,000

Composition of forest in T. 37 S., R. 6 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	10
Sugar pine	.6
White pine	.9
Lodgepole pine	22
Red fir	3
White fir	20
Noble fir	18
Alpine hemlock	20
Engelmann spruce	5

Township 37 South, Range 7 East.

The eastern areas of this township comprise a broken lava slope, with ridges of low elevation rising here and there, bordering the western shore of Upper Klamath Lake. The central areas comprise a portion of Aspen Lake, with various marshy tracts adjoining, while the western sections rise into a range of high and steep mountains.

The areas fronting on Upper Klamath Lake are thinly forested with scattered trees of yellow pine, lodgepole pine, and white fir. The western and the higher ground of the central areas bear much excellent yellow pine, standards and veterans, with good, clear body.

The forest is everywhere in the township badly fire marked, and in the western areas are many tracts where 50 per cent of the standing timber is dead from this cause.

Forested and other areas in T. 37 S., R. 7 E., Oregon.

	Acres.
Forested area	19,140
Nonforested area (marsh and lake)	3,900
Badly burned area	5,300
Logged area (culled 10 per cent)	1,000

Total stand of timber in T. 37 S., R. 7 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	91.7	110,000,000	135,800,000
Red fir	5	6,000,000	10,000,000
White fir	3.3	4,000,000	24,000,000
Total	....	120,000,000	169,800,000

Composition of forest in T. 37 S., R. 7 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	75
Lodgepole pine	5
Red fir	2
White fir	18
Western juniper	Scattered trees.

TOWNSHIP 37 SOUTH, RANGE 8 EAST.

This township lies mostly in Upper Klamath Lake, only an inconsiderable area in the western portion carrying thin stands of yellow pine.

Forested and other areas in T. 37 S., R. 8 E., Oregon.

	Acres.
Forested area	700
Nonforested area (marsh and lake)	22,700

Total stand of timber in T. 37 S., R. 8 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	....	....	1,400,000

TOWNSHIP 37 SOUTH, RANGE 9 EAST.

The eastern areas of this township consist of marshy grass, or drier agricultural lands forming the western portion of Swan Lake Valley. The western sections comprise rough semiarid hills; the eastern sides are sparsely timbered with small-growth yellow pine; the western are bare or with scattered trees; the intervening valleys are mostly covered with sage or with rabbit brush where water for irrigation is not available.

Forested and other areas in T. 37 S., R. 9 E., Oregon.

	Acres.
Forested area	10, 880
Nonforested area (brush-covered semiarid tracts, meadows, etc.)	12, 160
Logged area	None.

Total stand of timber in T. 37 S., R. 9 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	20, 000, 000	40, 320, 000

Composition of forest in T. 37 S., R. 9 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	99
Other species	1

TOWNSHIP 37 SOUTH, RANGE 10 EAST.

The central, western, and southern areas of this township consist of grazing and agricultural lands in Swan Lake Valley, which is a flat, dried-up lake bottom bounded on the east by a remarkably steep and precipitous, very thinly-forested mass of lava. The northern and western sides of the valley are inclosed by broken ridges and slopes, while the southern end connects with the treeless areas of Alkali Flat. The northeastern portions of the township consist of the terraced eastern slope of Swan Lake Point and bear the forest. This is chiefly composed of scattered stands of medium quality yellow pine mixed with considerable quantities of small-growth red fir and incense cedar. The tract has been culled over for years, and most of the more valuable incense cedar has been cut away and removed. Fires have run throughout, and the forest is in consequence much broken by brushed-over fire glades.

Forested and other areas in T. 37 S., R. 10 E., Oregon.

	Acres.
Forested area	6, 880
Nonforested area (meadow and agricultural lands)	16, 160
Badly burned area	800
Logged area (culled 35 per cent)	3, 800

Total stand of timber in T. 37 S., R. 10 E., Oregon.

Species.	Local practice		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	83.2	25,000,000	32,000,000
Sugar pine			400,000
Red fir	16.8	5,000,000	5,000,000
White fir			5,000,000
Incense cedar			700,000
Total		30,000,000	43,100,000

Composition of forest in T. 37 S., R. 10 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	88
Sugar pine	.2
Lodgepole pine	.8
Red fir	6
White fir	3
Incense cedar	1
Western juniper	1

TOWNSHIP 37 SOUTH, RANGE 11½ EAST.

The central and southern areas of this township consist of semiarid lands with scattered poplar groves around the springs, or with thin stands of western juniper, or covered with bowlders and naked masses of rock and wholly nonforested. The northwestern and northeastern portions carry thin stands of inferior quality yellow pine. The timber is easy of access, but of little commercial value.

Forested and other areas in T. 37 S., R. 11½ E., Oregon.

	Acres.
Forested area	8,320
Nonforested area (bare rocks, semiarid tracts, grazing and agricultural)	14,720
Logged area	None.

Total stand of timber in T. 37 S., R. 11½ E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	12,000,000	18,500,000

Composition of forest in T. 37 S., R. 11½ E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	93
Lodgepole pine	1
Western juniper	1
Poplar	1

TOWNSHIP 37 SOUTH, RANGE 11 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 37 S., R. 11 E., Oregon.

	Acres.
Forested area	19,200
Nonforested area	3,840

Total stand of timber in T. 37 S., R. 11 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	40,000,000	57,600,000

TOWNSHIP 37 SOUTH, RANGE 12 EAST.

This township was not examined personally, but was estimated from information.

Forested and other areas in T. 37 S., R. 12 E., Oregon.

	Acres.
Forested area	20,140
Nonforested area	2,900

Total stand of timber in T. 37 S., R. 12 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	65,000,000	94,000,000
White fir			6,000,000
Total	100	65,000,000	100,000,000

TOWNSHIP 37 SOUTH, RANGE 13 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 37 S., R. 13 E., Oregon.

	Acres.
Forested area	20,440
Nonforested area	2,600

Total stand of timber in T. 37 S., R. 13 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	60,000,000	95,000,000

TOWNSHIP 37 SOUTH, RANGE 14 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 37 S., R. 14 E., Oregon.

	Acres.
Forested area	17,040
Nonforested area	6,000

Total stand of timber in T. 37 S., R. 14 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	Feet B. M.	Feet B. M.
Yellow pine	94	30,000,000	42,000,000
White fir	6	2,000,000	10,000,000
Total	....	32,000,000	52,000,000

TOWNSHIP 38 SOUTH, RANGE 2 WEST.

This township covers a region of low but steep hills west of Bear Creek Valley. The valuable timber on these tracts has long ago been cut or burned, leaving nothing but a trace of the forest.

Forested and other areas in T. 38 S., R. 2 W., Oregon.

	Acres.
Forested area	17,840
Nonforested area	5,200
Badly burned area	6,500
Logged area (60 per cent)	Throughout.

Total stand of timber in T. 38 S., R. 2 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	Feet B. M.	Feet B. M.
Yellow pine	100	12,000,000	30,000,000

Composition of forest in T. 38 S., R. 2 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	70
Red fir	28
Oak, madroña	2

Township 38 South, Range 1 West.

This township consists of grazing and agricultural lands in Bear Creek Valley. The tree growth is composed of orchard stands and of thin fringes of willows, cottonwoods, Oregon ash, and maple along the banks of the stream.

Forested and other areas in T. 38 S., R. 1 W., Oregon.

	Acres.
Forested area	None.
Nonforested area	23, 040

Township 38 South, Range 1 East.

The western and central areas of this township are situated in Bear Creek Valley and consist of grazing and agricultural lands. The eastern portions comprise slopes of Grizzly Range. The western declivities of the range are very sparsely timbered with scattered groups of yellow pine. The summit and eastern slopes bear light stands of yellow pine and red fir of small growth.

Forested and other areas in T. 38 S., R. 1 E., Oregon.

	Acres.
Forested area	11, 440
Nonforested area (grazing and agricultural)	11, 600
Logged area (culled, 65 per cent)	4, 600

Total stand of timber in T. 38 S., R. 1 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	10, 000, 000	22, 000, 000
Red fir			1, 600, 000
Total		10, 000, 000	23, 600, 000

Composition of forest in T. 38 S., R. 1 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent
Yellow pine	98
Red fir	1
Oak	1

Township 38 South, Range 2 East.

The western portion of this township comprises Grizzly Peak and radiating ridges, rocky and lightly timbered with small red fir, noble fir, and white fir, badly burned throughout.

The central and eastern areas consist of steep escarpments, rising abruptly to the upper plateau of the Cascades, and bear scattered stands of small-growth mill timber, culled of its best portions, in the neighborhood of the various settlements east of Grizzly Range.

Forested and other areas in T. 38 S., R. 2 E., Oregon.

	Acres
Forested area	12, 040
Nonforested area (burned, 3,000; glades, etc., 8,000)	11, 000
Badly burned area	5, 800
Logged area (culled 40 per cent)	6, 000

Total stand of timber in T. 38 S., R. 2 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	25	5, 000, 000	11, 000, 000
Red fir	75	15, 000, 000	33, 000, 000
White fir			3, 000, 000
Noble fir			1, 000, 000
Total		20, 000, 000	48, 000, 000

Composition of forest in T. 38 S., R. 2 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	20
Sugar pine	.1
Red fir	70
White fir	6
Noble fir	.9
Oak, mountain mahogany	3

TOWNSHIP 38 SOUTH, RANGE 3 EAST.

The central sections of this township consist of a series of open, grassy glades, used for grazing and agriculture. The northern and southern areas comprise low ranges of hills bearing excellent stands of yellow pine and red fir.

Fires have ravaged much of the timbered sections, destroying 25 per cent of the timber. The burned tracts do not reforest readily, but instead become covered with dense brush growths. Here, as everywhere else in the region lying on the western plateau of the Cascades, cattle range through the forest. Every glade or grass patch is badly overgrazed, and the trampling by stock when the ground is wet in spring or autumn prevents the small glades from becoming forested, as they would otherwise do, in most cases.

Forested and other areas in T. 38 S., R. 3 E., Oregon.

	Acres.
Forested area	17,340
Nonforested area (meadows and glades)	5,700
Badly burned area	5,800
Logged area (culled, 75 per cent)	2,000

Total stand of timber in T. 38 S., R. 3 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	33.3	42,000,000	55,000,000
Sugar pine	2.4	3,000,000	3,000,000
Red fir	63.5	80,000,000	92,000,000
White fir			4,880,000
Incense cedar	.8	1,000,000	2,000,000
Total		126,000,000	156,880,000

Composition of forest in T. 38 S., R. 3 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	40
Sugar pine	.6
Red fir	55
White fir	3.7
Incense cedar	.1
Pacific yew	.1

Township 38 South, Range 4 East.

The southeastern portions of this township comprise a series of high, steep ridges forming the crest of the main range of the Cascades. The balance of the township consists of a plateau-like tract intersected by low ridges and numerous small grassy glades. The forest stands are extremely uneven. In the southern and central areas occur large burned-over tracts covered with brush and alternating with stands of small-growth white fir. In the northeastern corner is a low, swampy tract bearing a forest stand of massive proportion composed of white, red, and noble fir. The trees here are often as much as 8 feet in diameter and 200 feet in height. The yellow pine is of good quality and size. Most of the timber is easy of access from the west.

Forested and other areas in T. 38 S., R. 4 E., Oregon.

	Acres.
Forested area	17,340
Nonforested area (burned, 2,800; glades, etc., 2,900)	5,700
Badly burned area	7,000
Logged area	None.

Total stand of timber in T. 38 S., R. 4 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	19	38, 000, 000	44, 000, 000
Sugar pine	3. 5	7, 000, 000	8, 000, 000
White pine	2. 5	5, 000, 000	5, 900, 000
Red fir	60	120, 000, 000	145, 000, 000
White fir	5	10, 000, 000	20, 000, 000
Noble fir	10	20, 000, 000	25, 000, 000
Total		200, 000, 000	247, 900, 000

Composition of forest in T. 38 S., R. 4 E., Oregon, including trees of all species, with basal diameters of 4 inches and upward:

	Per cent.
Yellow pine	20
Sugar pine	3
White pine	2
Red fir	55
White fir	10
Noble fir	9. 2
Yew, etc	. 8

TOWNSHIP 38 SOUTH, RANGE 5 EAST.

The western and central areas of this township comprise high, rocky ridges which here form the backbone of the main range of the Cascades. They have been heavily timbered, but are now badly burned and covered with wide, dense brush growths surrounding irregular stands of red, white, and noble fir. The eastern portions consist of a marshy area called Buck Lake, a level flat north thereof, burned in recent times and now reforested with a thin growth of lodgepole pine, and an area of rocky slopes east of Buck Lake bearing scattered stands of medium quality yellow pine and much brush, the result of fires.

Forested and other areas in T. 38 S., R. 5 E., Oregon.

	Acres.
Forested area	17, 040
Nonforested area (burned, 3,000; meadows, etc., 3,000)	6, 000
Badly burned area	4, 000
Logged area	None.

Total stand of timber in T. 38 S., R. 5 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	40	36,000,000	45,000,000
Sugar pine	2.2	2,000,000	2,000,000
White pine	1.1	1,000,000	1,200,000
Red fir	56.7	51,000,000	90,000,000
White fir			4,000,000
Noble fir			13,000,000
Incense cedar			300,000
Western hemlock			500,000
Total		90,000,000	156,000,000

Composition of forest in T. 38 S., R. 5 E., Oregon, including trees of all species with basal diameters of 4 inches and upward:

	Per cent.
Yellow pine	25
Sugar pine	1
White pine	Occasional trees.
Lodgepole pine	6
Red fir	55
White fir	5
Noble fir	8
Incense cedar	Scattered trees.
Western hemlock	Scattered trees.

TOWNSHIP 38 SOUTH, RANGE 6 EAST.

The central and southern portions of the township comprise well-timbered ridges and slopes bordering Spencer Creek—a continuation of the heavy forest in T. 39 S., R. 6 E.

The northern areas consist of marshy tracts at the south end of Buck Lake and burned and brushed over slopes.

Forested and other areas in T. 38 S., R. 6 E., Oregon.

	Acres.
Forested area	19,440
Nonforested area (burned)	3,600
Badly burned area	5,000
Logged area	None.

Total stand of timber in T. 38 S., R. 6 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	28.6	40,000,000	64,000,000
Sugar pine	14.3	20,000,000	22,000,000
White pine	2	3,000,000	3,000,000
Red fir	46	65,000,000	103,000,000
White fir			6,000,000
Noble fir	7.2	10,000,000	15,000,000
Alpine hemlock			2,000,000
Engelmann spruce	1.4	2,000,000	3,000,000
Total		140,000,000	218,000,000

Composition of forest in T. 38 S., R. 6 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	30
Sugar pine	6
White pine	.8
Red fir	45
White fir	5
Noble fir	10
Alpine hemlock	2
Western hemlock	.2
Engelmann spruce	1

TOWNSHIP 38 SOUTH, RANGE 7 EAST.

The western areas of the township comprise a portion of Aspen Lake, a shallow sheet of water, and steep, rocky slopes forming the divide between Aspen Lake and Spencer Creek. The eastern portion of the township consists of a rolling lava plateau with low ridges in the eastern sections. The plateau portion is covered with a nearly uniform stand of forest of good quality, yellow pine largely predominating.

The forest is fire marked throughout.

Forested and other areas in T. 38 S., R. 7 E., Oregon.

	Acres.
Forested area	18,540
Nonforested area (lakes, marshes, and glades)	4,500
Badly burned area	3,200
Logged area	None.

Total stand of timber in T. 38 S., R. 7 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	86.5	160,000,000	118,000,000
Red fir	13.5	25,000,000	57,000,000
White fir			15,700,000
Total		185,000,000	190,700,000

Composition of forest in T. 38 S., R. 7 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	60
Red fir	30
White fir	8
Western juniper	2

TOWNSHIP 38 SOUTH, RANGE 8 EAST.

The eastern and central areas of this township consist chiefly of marsh, bordering Upper Klamath Lake, and areas covered with the waters of this lake. The western tracts carry thin stands of yellow pine and small-growth red and white fir scattered over low lava ridges. Fires have run throughout, and in the vicinity of Long Lake Valley, a marshy meadow, have burned 85 per cent of the forest.

Forested and other areas in T. 38 S., R. 8 E., Oregon.

	Acres.
Forested area	5,760
Nonforested area (marsh and lake)	17,280
Badly burned area	1,500
Logged area (culled for domestic use, 30 per cent)	None.

Total stand of timber in T. 38 S., R. 8 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	8,000,000	14,300,000
Red fir			3,500,000
White fir			3,960,000
Total		8,000,000	21,760,000

Composition of forest in T. 38 S., R. 8 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	74
Red fir	10
White fir	15
Sugar pine Lodgepole pine Incense cedar Western juniper	1

Township 38 South, Range 9 East.

The western portions of the township comprise meadow, marsh, and sagebrush-covered semiarid tracts. The central and eastern sections are hilly regions, the ridges mostly nonforested on the western slopes and timbered on the summits and eastern sides with a thin, light forest mostly valuable for fuel purposes.

Forested and other areas in T. 38 S., R. 9 E., Oregon.

	Acres.
Forested area	5,760
Nonforested area (lake, marsh, and semiarid tracts)	17,280
Badly burned area	800

Total stand of timber in T. 38 S., R. 9 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	4,500,000	11,520,000

Composition of forest in T. 38 S., R. 9 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	99
Western juniper	1

Township 38 South, Range 10 East.

The eastern and central areas of the township consist of grassy and marshy tracts around Swan Lake; the western part consists of low ranges of hills which bear thin stands of yellow pine of small dimensions.

Forested and other areas in T. 38 S., R. 10 E., Oregon.

	Acres.
Forested area	10,880
Nonforested area (meadow and agricultural lands)	12,160
Logged area (culled 30 per cent)	1,100

Total stand of timber in T. 38 S., R. 10 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	11,000,000	22,000,000

Composition of forest in T. 38 S., R. 10 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	95
Western juniper	4
Poplar, etc	1

TOWNSHIP 38 SOUTH, RANGE 11½ EAST.

This township consists chiefly of nonforested areas in and adjoining Alkali Flat, a semiarid, sagebrush-covered region.

In the southwestern areas are low hills, which carry a scattered growth of western juniper, with now and then a yellow pine.

Forested and other areas in T. 38 S., R. 11½ E., Oregon.

	Acres.
Forested area	1,640
Nonforested area (grazing, agricultural, and semiarid lands)	21,400

Total stand of timber in T. 38 S., R. 11½ E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	....	....	2,240,000

Composition of forest in T. 38 S., R. 11½ E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

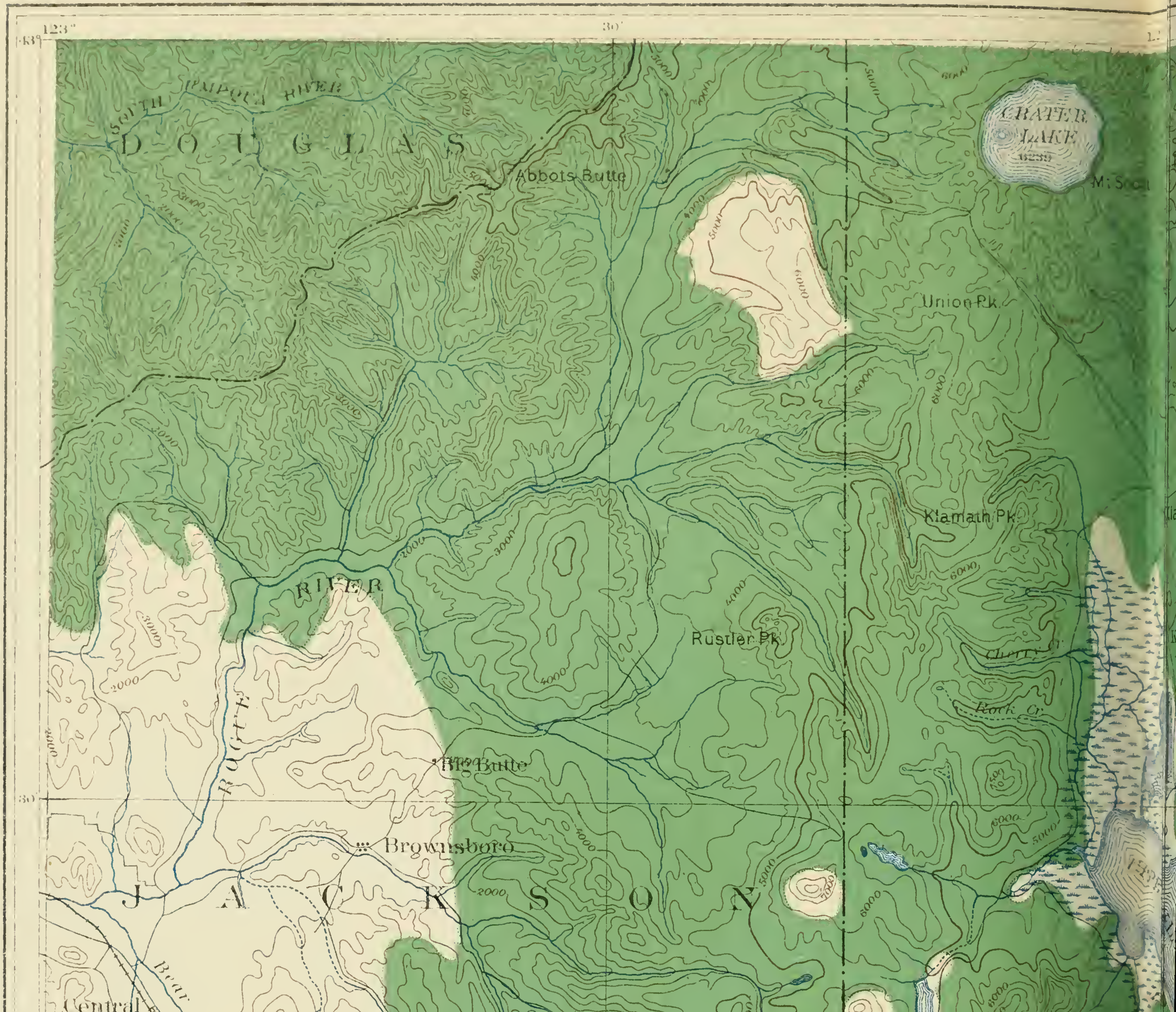
	Per cent.
Yellow pine	5
Western juniper	95

TOWNSHIP 38 SOUTH, RANGE 11 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 38 S., R. 11 E., Oregon.

	Acres.
Forested area	14,040
Nonforested area	9,000



PART OF SOUTHERN OREGON SHOWIN

Prepared under the direction of He

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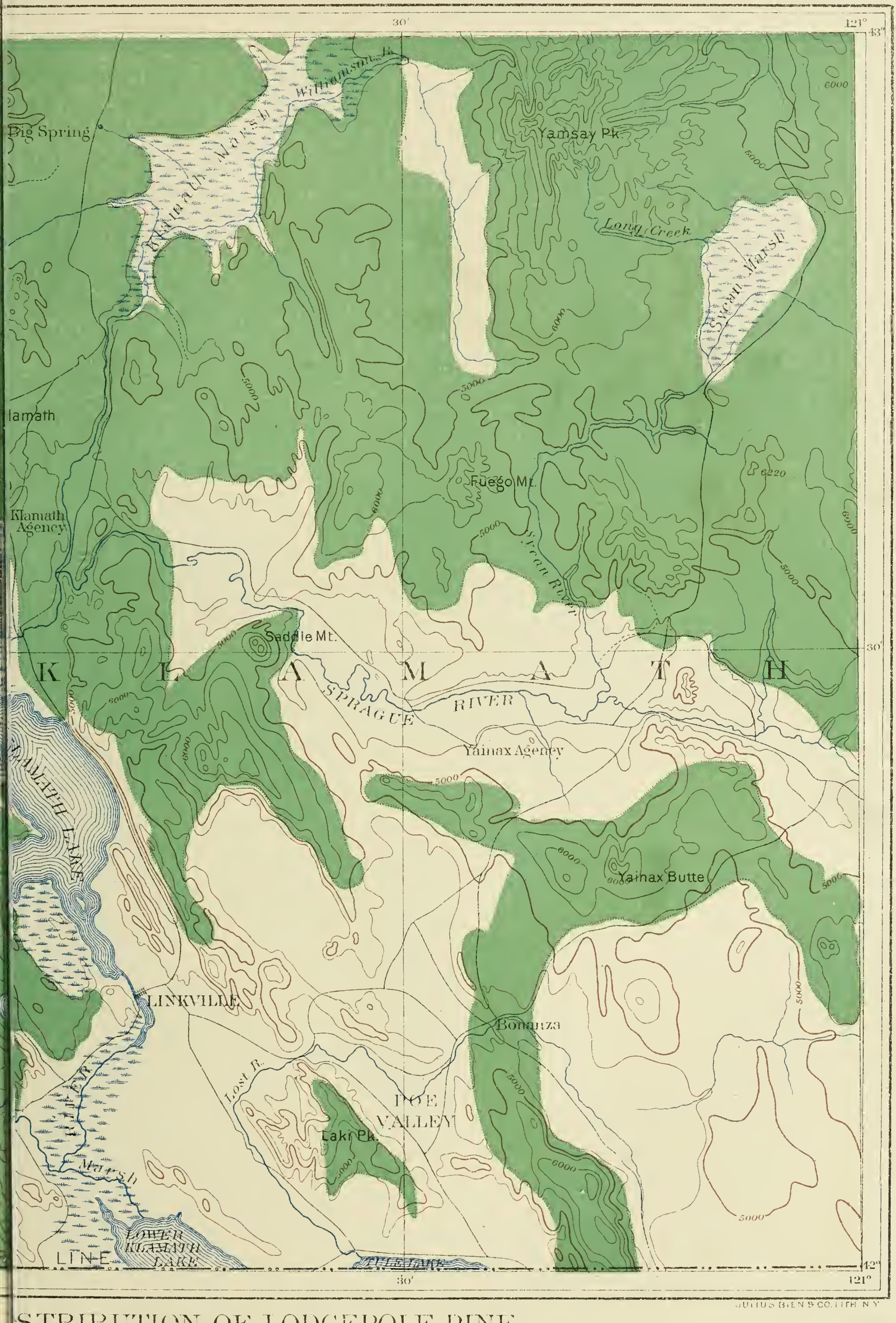

JULIUS BIEN & CO. LITH. N.Y.

STRIBUTION OF LODGEPOLE PINE

nnett, Geographer in charge

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Total stand of timber in T. 38 S., R. 11 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	38,000,000	53,000,000
Red fir			5,000,000
White fir			4,000,000
Total		38,000,000	62,000,000

TOWNSHIP 38 SOUTH, RANGE 12 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 38 S., R. 12 E., Oregon.

	Acres.
Forested area	17,240
Nonforested area	5,800

Total stand of timber in T. 38 S., R. 12 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	40,000,000	84,000,000
White fir			2,000,000
Incense cedar			500,000
Total		40,000,000	86,500,000

TOWNSHIP 38 SOUTH, RANGE 13 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 38 S., R. 13 E., Oregon.

	Acres.
Forested area	13,140
Nonforested area	9,900

Total stand of timber in T. 38 S., R. 13 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	28,000,000	38,000,000
White fir			4,000,000
Incense cedar			2,000,000
Total		28,000,000	44,000,000

TOWNSHIP 38 SOUTH, RANGE 14 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 38 S., R. 14 E., Oregon.

	Acres.
Forested area	9,040
Nonforested area	14,000

Total stand of timber in T. 38 S., R. 14 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	5,500,000	8,000,000

TOWNSHIP 39 SOUTH, RANGE 2 WEST.

This township is largely made up of areas semiarid in character, supporting extensive brush growths, but little timber.

The once forested tracts have been badly burned, and in place of the forest have come oak copses, madroña, and thickets of "chaparral."

The forest has been pretty well culled of its dimension stuff long ago, and what remains is mostly small growth and of little commercial value.

Forested and other areas in T. 39 S., R. 2 W., Oregon.

	Acres.
Forested area	9,040
Nonforested area (burned, 2,500; naturally nonforested, 11,500)	14,000
Badly burned area	2,500
Logged area (culled 50 per cent)	All.

Total stand of timber in T. 39 S., R 2 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	81.3	13,000,000	29,000,000
Red fir	18.7	3,000,000	6,000,000
Total		16,000,000	35,000,000

Composition of forest in T. 39 S., R. 2 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	80
Red fir	10
Oak, madroña	10

TOWNSHIP 39 SOUTH, RANGE 1 WEST.

This township comprises steep rocky slopes, draining partly into Applegate Creek, partly into Bear Creek.

Originally of good proportion, the forest has been culled during many years and stripped of its best timber, only a trace remaining.

Fires have wrought great havoc and have transformed many of the slopes into great brush heaps with thin lines of half-dead trees in their midst.

Forested and other areas in T. 39 S., R. 1 W., Oregon.

	Acres.
Forested area	17,240
Nonforested area (rocky slopes, agricultural, etc.)	5,800
Badly burned area	3,100
Logged area (culled throughout 45 per cent)	All.

Total stand of timber in T. 39 S., R. 1 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	70	35,000,000	73,000,000
Sugar pine	8	4,000,000	9,000,000
Red fir	22	11,000,000	21,000,000
Total		50,000,000	103,000,000

Composition of forest in T. 39 S., R. 1 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	70
Sugar pine	8
Red fir	20
Oak, madroña	2

TOWNSHIP 39 SOUTH, RANGE 1 EAST.

The extreme western portions of this township consist of low, sparsely timbered slopes, with heavier stands in the ravines; the central portions comprise agricultural and grazing lands while the eastern mainly include semiarid, rocky, nonforested slopes.

The forest is of poor quality throughout. Since the first settlement of the region it has been culled and burned repeatedly. Private holdings have conserved some of the better portions. In general the timber is of little commercial value.

Forested and other areas in T. 39 S., R. 1 E., Oregon.

	Acres.
Forested area	8,040
Nonforested area	15,000
Logged area (culled 50 per cent)	All.

Total stand of timber in T. 39 S., R. 1 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	68.7	11,000,000	22,000,000
Sugar pine	18.7	3,000,000	7,000,000
Red fir	12.5	2,000,000	6,000,000
Total		16,000,000	35,000,000

Composition of forest in T. 39 S., R. 1 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	60
Sugar pine	15
Red fir	20
Oak, madroña	5

TOWNSHIP 39 SOUTH, RANGE 2 EAST.

This township consists mostly of steep rocky breaks rising abruptly from Bear Creek Valley toward the Siskiyou-Cascades junction in the east.

A large proportion of the region is naturally nonforested. The forested areas bear thin stands of scattered yellow pine and red fir mixed with copses of oak. The timber is all of poor quality.

Forested and other areas in T. 39 S., R. 2 E., Oregon.

	Acres.
Forested area	10,540
Nonforested area (mostly rocky breaks naturally nonforested)	12,500
Badly burned area	1,200
Logged area	Culled throughout.

Total stand of timber in T. 39 S., R. 2 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	6,000,000	7,000,000
Red fir			3,000,000
Total		6,000,000	10,000,000

Composition of forest in T. 39 S., R. 2 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	62
Red fir	35
Oak, etc	3

Township 39 South, Range 3 East.

This township covers the areas at the junction of the Siskiyou and the Cascade ranges, and consists of rocky flats and ridges forming the upper drainage basin of Jenny Creek.

The forest contains a large quantity of red fir, small in growth and badly damaged by the numerous fires which have overrun the township in recent times. The yellow pine is short bodied, as is the usual condition on the rocky areas of this region.

Where fires have burned all the timber, brush growths are the rule.

Forested and other areas in T. 39 S., R. 3 E., Oregon.

	Acres.
Forested area	19,140
Nonforested area, (2,000 burned clean of timber)	3,900
Badly burned area	3,000
Logged area	None.

Total stand of timber in T. 39 S., R. 3 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	51.3	40,000,000	65,000,000
Sugar pine	10.2	8,000,000	10,000,000
Red fir	38.5	30,000,000	55,000,000
White fir			6,300,000
Total		78,000,000	136,300,000

Composition of forest in T. 39 S., R. 3 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	60
Sugar pine	3
Red fir	32
White fir	5

Township 39 South, Range 4 East.

This township comprises most of the eastern areas of the Jenny Creek watershed and consists, in its eastern portion, of a level or gently rolling plateau region; in its western sections of hilly and broken ground. Its central areas contain Johnson Prairie, a large glade with many small ramifications. Fires have run throughout the entire extent of the township. The northern areas are very badly burned, extensive tracts being completely covered with brush growth as a result. The central and southern portions carry a heavy forest of yellow pine, excellent in quality and easy of access. The red fir is inferior in growth and quality, due to the many fires in the region.

Forested and other areas in T. 39 S., R. 4 E., Oregon.

	Acres.
Forested area	18,040
Nonforested area (glades and meadows, 2,000; burned 3,000)	5,000
Badly burned area	5,600
Logged area	None.

Total stand of timber in T. 39 S., R. 4 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	57.5	100,000,000	122,000,000
Sugar pine	14.3	25,000,000	31,000,000
Red fir	25.8	45,000,000	80,000,000
White fir	1.2	2,000,000	4,000,000
Incense cedar	1.2	2,000,000	2,850,000
Total		174,000,000	239,850,000

Composition of forest in T. 39 S., R. 4 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	50
Sugar pine	8
Red fir	40
White fir Incense cedar	2

Township 39 South, Range 5 East.

This township consists of a plateau region which forms portions of the summit of the main range of the Cascades in this region.

The northwestern areas are chiefly meadow lands, glades belonging to the Johnson Prairie tracts. The balance of the township carries a tolerably compact body of excellent yellow pine, largely composed of standards.

Fires have run everywhere in the forest stands, suppressing the young growth, burning great quantities of the firs, and filling the forest with a great many small brushed-over tracts in place of the consumed timber.

Forested and other areas in T. 39 S., R. 5 E., Oregon.

	Acres.
Forested area	21,140
Nonforested area (meadows and glades)	1,900
Badly burned area	6,000
Logged area	None.

Total stand of timber in T. 39 S., R. 5 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	61.5	160,000,000	188,000,000
Sugar pine	10.6	28,000,000	28,000,000
Red fir	25	65,000,000	95,000,000
White fir	1.5	3,000,000	10,000,000
Noble fir	.7	2,000,000	4,000,000
Incense cedar	.7	2,000,000	3,000,000
Total		260,000,000	328,000,000

Composition of forest in T. 39 S., R. 5 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	60
Lodgepole pine	1
White fir	2.9
Incense cedar	.1
Sugar pine	4
Red fir	30
Noble fir	2

TOWNSHIP 39 SOUTH, RANGE 6 EAST.

This township in part consists of areas along the summit of the Cascades, and has not elevation sufficient to produce a true subalpine forest. In part it consists of slopes on the eastern side of the range draining into Spencer Creek.

The forest has been severely burned in places, followed by the inevitable brush growths. The western areas and the slopes near Spencer Creek bear good stands of mill timber.

Forested and other areas in T. 39 S., R. 6 E., Oregon.

	Acres.
Forested area	18,840
Nonforested area (burned, 2,000; glades and meadows, 2,200)	4,200
Badly burned area	5,400
Logged area	None.

Total stand of timber in T. 39 S., R. 6 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	32.6	50,000,000	60,000,000
Sugar pine	9.8	15,000,000	15,000,000
Red fir	53.7	82,000,000	105,000,000
White fir	3.9	6,000,000	15,000,000
Incense cedar			800,000
Total		153,000,000	195,800,000

Composition of forest in T. 39 S., R. 6 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	31
Sugar pine	7
Red fir	50
White fir	10
Incense cedar	1
Lodgepole pine	1

Township 39 South, Range 7 East.

This township is situated on the eastern slope of the main range of the Cascades. Its western areas contain stands of forest of medium density and quality; its southern areas have thin growths of forest, largely western juniper; its eastern areas adjoin the nonforested semiarid tracts west of Upper Klamath Lake and carry scattered stands of forest of small commercial value.

Forested and other areas in T. 39 S., R. 7 E., Oregon.

	Acres.
Forested area	18,040
Nonforested area (naturally nonforested)	5,000
Badly burned area	1,850
Logged area (culled 35 per cent)	2,000

Total stand of timber in T. 39 S., R. 7 E., Oregon.

Species.	Local practice..		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	76.4	42,000,000	70,000,000
Sugar pine	5.4	3,000,000	3,000,000
Red fir	18.2	10,000,000	15,000,000
White fir			7,000,000
Incense cedar			900,000
Total		55,000,000	95,900,000

Composition of forest in T. 39 S., R. 7 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	73
Sugar pine	3
Red fir	13
White fir	7
Incense cedar	.2
Western juniper	3.8

TOWNSHIP 39 SOUTH, RANGE 8 EAST.

The western sections of the township consist of low lava hills sparsely timbered, inclosing marshy or sagebrush-covered flats. The eastern areas comprise sagebrush-covered, nonforested semiarid flats and low hills. The forest is of poor quality owing to proximity of arid climatic conditions and to frequent fires.

Forested and other areas in T. 39 S., R. 8 E., Oregon.

	Acres.
Forested area	8, 320
Nonforested area (meadows and semiarid areas)	14, 720
Badly burned area	4, 600

Total stand of timber in T. 39 S., R. 8 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	6, 000, 000	10, 880, 000

Composition of forest in T. 39 S., R. 8 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	97
Western juniper	3

TOWNSHIP 39 SOUTH, RANGE 9 EAST.

This township is situated east of the Cascades and consists of marsh and sagebrush flats and hills. The area of the township is 23,040 acres and it contains no forested tracts.

TOWNSHIP 39 SOUTH, RANGE 10 EAST.

This township was estimated from information and was not personally examined.

Forested and other areas in T. 39 S., R. 10 E., Oregon.

	Acres.
Forested area	4,540
Nonforested area	18,500

Total stand of timber in T. 39 S., R. 10 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	6,000,000	10,000,000

TOWNSHIP 39 SOUTH, RANGE 11½ EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 39 S., R. 11½ E., Oregon.

	Acres.
Forested area	7,680
Nonforested area	15,360

Total stand of timber in T. 39 S., R. 11½ E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	16,000,000	22,500,000

TOWNSHIP 39 SOUTH, RANGE 11 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 39 S., R. 11 E., Oregon.

	Acres.
Forested area	15,440
Nonforested area	7,600

Total stand of timber in T. 39 S., R. 11 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	55,000,000	85,000,000
White fir			5,000,000
Total		55,000,000	90,000,000

TOWNSHIP 39 SOUTH, RANGE 12 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 39 S., R. 12 E., Oregon.

	Acres.
Forested area	7,640
Nonforested area	15,400

Total stand of timber in T. 39 S., R. 12 E., Oregon.

Species.	Local practice.		Michigan standard.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	30,000,000	42,000,000
White fir			4,000,000
Total		30,000,000	46,000,000

Township 39 South, Range 13 East.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 39 S., R. 13 E., Oregon.

	Acres.
Forested area	4,440
Nonforested area	18,600

Total stand of timber in T. 39 S., R. 13 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	16,000,000	22,000,000

Township 39 South, Range 14 East.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 39 S., R. 14 E., Oregon.

	Acres.
Forested area	8,040
Nonforested area	15,000

Total stand of timber in T. 39 S., R. 14 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	5,000,000	8,000,000

Township 40 South, Range 2 West.

The northern areas of this township consist of low broken spurs and ridges; the southern comprise high steep slopes, all of which are formed by northward projecting ridges from the Siskiyou Mountains; the whole constituting the different divides between the various Applegate forks.

The forest in the southern areas consists mostly of noble fir at the higher elevations; at lower levels it changes to a growth in which red fir forms 60 per cent of the stand. The southern tracts of the township have been burned clean to the extent of 30 per cent in recent times, and are now reforesting with a nearly pure growth of red fir. The northern portions carry stands of yellow pine, much culled and extensively mixed with oak copses and madroña of large growth.

Forested and other areas in T. 40 S., R. 2 W., Oregon.

	Acres.
Forested area	19, 240
Nonforested area (rocks and glades)	3, 800
Badly burned area	4, 300
Logged area (culled 65 per cent)	1, 800

Total stand of timber in T. 40 S., R. 2 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	56.	42, 000, 000	60, 000, 000
Sugar pine	6. 6	5, 000, 000	5, 000, 000
Red fir	29. 3	22, 000, 000	45, 000, 000
Noble fir	6. 6	5, 000, 000	7, 000, 000
Incense cedar	1. 4	1, 000, 000	2, 000, 000
Total		75, 000, 000	119, 000, 000

Composition of forest in T. 40 S., R. 2 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	40.
Sugar pine	2.
Red fir	45.
Noble fir	3.
Incense cedar	. 5
Madroña Oak	9. 5

Township 40 South, Range 1 West.

This township consists of high slopes and summits of the Siskiyou Range. The highest slopes are largely nonforested, either bare, rocky expanses or grassy glades predominating. The lower elevations bear moderately heavy stands of fair quality. The forest is seared by fire in all of its parts, and is generally difficult of access.

A portion of the township forms part of the Ashland Forest Reserve.

Forested and other areas in T. 40 S., R. 1 W., Oregon.

	Acres.
Forested area	17,040
Nonforested area (bare, rocky summits, etc., 4,200; burned clean, 2,800)	6,000
Badly burned area	6,200
Logged	None.

Total stand of timber in T. 40 S., R. 1 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	28.5	20,000,000	26,000,000
Sugar pine	11.4	8,000,000	8,000,000
White pine			1,000,000
Red fir	40	28,000,000	55,000,000
White fir			3,000,000
Noble fir	17.2	12,000,000	14,000,000
Incense cedar	2.9	2,000,000	3,000,000
Total		70,000,000	110,000,000

Composition of forest in T. 40 S., R. 1 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	20
Sugar pine	3
White pine	Scattered trees.
Red fir	50
White fir	3
Noble fir	12
Incense cedar	3
Oak, madroña	9

TOWNSHIP 40 SOUTH, RANGE 1 EAST.

This township consists chiefly of high rocky combs and ridges culminating in Siskiyou Peak. It forms the larger portion of the Ashland Forest Reserve. Along the higher slopes the forest occurs in scattered stands, largely composed of noble fir. The lower areas bear good stands of yellow and sugar pine. The red fir is mostly of small growth. Fires have run throughout the forest in the township. The summit of the ridge near Siskiyou Peak has been burned to the extent of 75 per cent within the last two or three years. Although a forest reserve for the purpose of supplying the town of Ashland with pure water, sheep are permitted to graze on the high slopes, defiling the water.

Forested and other areas in T. 40 S., R. 1 E., Oregon.

	Acres.
Forested area	18,540
Nonforested area (glades, etc., 4,000; burned clean, 500)	4,500
Badly burned area	2,200
Logged area	500

Total stand of timber in T. 40 S., R. 1 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	21.8	21,000,000	36,000,000
Sugar pine	12.6	12,000,000	16,000,000
Red fir	26	25,000,000	50,000,000
Noble fir	36.4	35,000,000	50,000,000
White fir			8,000,000
Incense cedar	3.2	3,000,000	4,000,000
Total		96,000,000	164,000,000

Composition of forest in T. 40 S., R. 1 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	23
Sugar pine	10
White pine	Scattered trees.
White-bark pine	Scattered trees.
Red fir	30
White fir	5
Noble fir	30
Incense cedar	2
Oak, madroña	5

TOWNSHIP 40 SOUTH, RANGE 2 EAST.

This township is situated on the northern slopes of the Siskiyou Mountains and consists of rocky, broken hills rising in the east and south to join the main range.

Fires have run through the forest in recent times, burning 30 per cent of the timber and badly searing the remainder. The stands are light and scattered among bare, rocky flats and glades and dense brush growths.

The larger portion of the timber consists of small-growth red fir of little commercial value.

Forested and other areas in T. 40 S., R. 2 E., Oregon.

	Acres.
Forested area	13,540
Nonforested area (burned, 3,000)	6,500
Badly burned area	6,300
Logged area (culled 15 per cent)	1,200

Total stand of timber in T. 40 S., R. 2 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	20.8	5,000,000	15,000,000
Sugar pine	4.2	1,000,000	2,000,000
Red fir	75	18,000,000	45,000,000
White fir			2,000,000
Noble fir			4,000,000
Total		24,000,000	68,000,000

Composition of forest in T. 40 S., R. 2 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	25
Sugar pine	.2
Red fir	58
White fir	4
Noble fir	6
Incense cedar	.1
Oak, madroña	6.7

TOWNSHIP 40 SOUTH, RANGE 3 EAST.

This township consists of ridges and canyons projecting eastward from the Siskiyou Mountains, and forms portion of the Jenny Creek drainage basin.

It is a very broken region, with the forest mostly burned up long ago and in its place dense brush growths or here and there grassed-over slopes.

The mill timber is of small growth and of little value.

Forested and other areas in T. 40 S., R. 3 E., Oregon.

	Acres.
Forested area	12,040
Nonforested area (fire glades 5,200)	11,000
Badly burned area	8,200
Logged area	None.

Total stand of timber in T. 40 S., R. 3 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	22.2	10,000,000	16,000,000
Sugar pine	4.4	2,000,000	2,000,000
Red fir	73.4	33,000,000	51,200,000
Incense cedar			400,000
Total		45,000,000	69,600,000

Composition of forest in T. 40 S., R. 3 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	25
Sugar pine	.1
White fir	.1
Red fir	70
Incense cedar	.1
Oak	4.7

TOWNSHIP 40 SOUTH, RANGE 4 EAST.

The eastern areas of this township consist of portions of the large lava plateau which flanks the main summit of the Cascade Range north of the Klamath River. The western portions of the township comprise broken, unevenly forested ridges draining into Jenny Creek.

The mill timber in the eastern sections forms heavy stands, is excellent in quality, and easy of access. Fires have marked the entire forest stand in the township, and have mostly suppressed the young growth; hence the forest is of an open character, with but little undergrowth.

Forested and other areas in T. 40 S., R. 4 E., Oregon.

	Acres.
Forested area	19,740
Nonforested area (naturally nonforested)	3,300
Logged area	None.

Total stand of timber in T. 40 S., R. 4 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	56.5	120,000,000	132,000,000
Sugar pine	14.2	30,000,000	35,000,000
Red fir	28.3	60,000,000	70,000,000
White fir	.9	2,000,000	10,000,000
Incense cedar			1,000,000
Total		212,000,000	248,000,000

Composition of forest in T. 40 S., R. 4 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	60
Sugar pine	8
Red fir	30
White fir	1
Oak, incense cedar	1

TOWNSHIP 40 SOUTH, RANGE 5 EAST.

This township consists of a gently rolling lava plateau, a few low ridges here and there flanking and including portions of the main summit of the Cascade Range north of the Klamath River Canyon.

It bears a forest of noble proportions, ideally situated for lumbering operations. The most valuable components of the forest here are yellow and sugar pine. The growth of these two species is symmetrical and large, the sugar pine reaching basal diameters of 9 feet, and the yellow pine of 5 to 6 feet, with clear trunks 30 to 65 feet in length.

Fires have run through this stand of timber very many times, and there are not many trees not fire seared. The greatest damage has been done to the firs, both red and white, which therefore are largely defective and are not much cut for lumber. The young growth has also been destroyed, and reproduction is therefore defective.

The Pokegama Lumber Company operates here, sending the logs to their mills at Klamathon, on the Southern Pacific Railroad, by way of the Klamath River. They cut pine exclusively, and cut all pine clean as they go, leaving great accumulations of débris behind them for future fires. They take all trees far into the crown, trimming off the limbs and making the last cut on a basis of 7 to 8 inches in diameter at the small end. In consequence they realize about 40 per cent higher yield than the customary cruisers' estimates provide for.

Forested and other areas in T. 40 S., R. 5 E., Oregon.

	Acres.
Forested area	20, 440
Nonforested area	2, 600
Logged area	1, 600

Total stand of timber in T. 40 S., R. 5 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	50	150, 000, 000	170, 000, 000
Sugar pine	17. 7	53, 000, 000	60, 000, 000
Red fir	30	90, 000, 000	100, 000, 000
White fir	1. 7	5, 000, 000	17, 000, 000
Incense cedar	. 6	2, 000, 000	3, 620, 000
Total		300, 000, 000	350, 620, 000

Total stand of timber as per actual cutting practice, 600,000,000 feet B. M.

Composition of forest in T. 40 S., R. 5 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	50
Sugar pine	15
Red fir	30
White fir	4.5
Incense cedar	.5

Township 40 South, Range 6 East.

The western and central areas of this township consist of a continuation of the lava plateau referred to under T. 41 S., R. 5 E., and the forest is of similar character. The canyon of the Klamath River cuts the eastern portion of the township in two. It is a rocky and precipitous gorge, the slopes and bottom timbered with scattered trees and the forest along the north bluff badly burned.

East of the river we have heavy stands of yellow pine, logged in places by small local concerns.

Forested and other areas in T. 40 S., R. 6 E., Oregon.

	Acres.
Forested area	21,240
Nonforested area (glades)	1,800
Badly burned area	2,200
Logged area	1,800

Total stand of timber in T. 40 S., R. 6 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	63.7	165,000,000	190,000,000
Sugar pine	15.4	40,000,000	45,000,000
Red fir	19.3	50,000,000	75,000,000
White fir	1.6	4,000,000	9,000,000
Incense cedar			1,000,000
Total		259,000,000	320,000,000

Composition of forest in T. 40 S., R. 6 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	60
Sugar pine	15
Red fir	22
White fir Incense cedar	3

TOWNSHIP 40 SOUTH, RANGE 7 EAST.

The western areas of the township consist of plateau tracts; the eastern comprise rocky and craggy declivities sloping toward Lower Klamath Lake.

The western portions of the township contain stands of yellow pine of excellent quality and easy of access. The growth is much mixed with a great quantity of red fir of dimensions unfit for mill timber; and is intersected in all directions by narrow, nonforested, rocky or grassy glades.

Forested and other areas in T. 40 S., R. 7 E., Oregon.

	Acres.
Forested area	21,740
Nonforested area (glades and clearings)	1,300
Badly burned area	2,400
Logged area	1,500

Total stand of timber in T. 40 S., R. 7 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	77.7	140,000,000	175,000,000
Sugar pine	3.4	6,000,000	8,000,000
Red fir	18.9	34,000,000	65,000,000
Total		180,000,000	248,000,000

Composition of forest in T. 40 S., R. 7 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	40
Sugar pine	5
Red fir	55
Incense cedar	Scattered trees.

TOWNSHIP 40 SOUTH, RANGE 8 EAST.

The eastern areas of this township consist of marsh and tule lands bordering Lower Klamath Lake. The western portions comprise rocky slopes carrying stands of yellow pine, mostly of inferior quality.

Forested and other areas in T. 40 S., R. 8 E., Oregon.

	Acres.
Forested area	6,140
Nonforested area (rocky glades, marsh, and agricultural land)	16,900
Badly burned area	1,000
Logged area	1,600

Total stand of timber in T. 40 S., R. 8 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	87	20,000,000	40,000,000
Red fir	13	3,000,000	9,000,000
White fir			3,980,000
Total		23,000,000	52,980,000

Composition of forest in T. 40 S., R. 8 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	85
Red fir	10
White fir, etc	5

TOWNSHIP 40 SOUTH, RANGE 9 EAST.

The township consists of marsh lands, and in the eastern areas of sagebrush-covered tracts which bear, here and there, scattered trees of western juniper. The area of the township is 23,040 acres, none of which are forested.

TOWNSHIP 40 SOUTH, RANGE 10 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 40 S., R. 10 E., Oregon.

	Acres.
Forested area	7,040
Nonforested area	16,000

Total stand of timber in T. 40 S., R. 10 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	30,000,000	42,000,000

TOWNSHIP 40 SOUTH, RANGE 11 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 40 S., R. 11 E., Oregon.

	Acres.
Forested area	5,040
Nonforested area	18,000

Total stand of timber in T. 40 S., R. 11 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			5,000,000

TOWNSHIP 40 SOUTH, RANGE 12 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 40 S., R. 12 E., Oregon.

	Acres.
Forested area	11,040
Nonforested area	12,000

Total stand of timber in T. 40 S., R. 12 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	36,000,000	50,000,000

TOWNSHIP 40 SOUTH, RANGE 13 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 40 S., R. 13 E., Oregon.

	Acres.
Forested area	10,240
Nonforested area	12,800

Total stand of timber in T. 40 S., R. 13 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	95.2	40,000,000	50,000,000
Red fir	4.8	2,000,000	5,000,000
White fir			6,000,000
Incense cedar			1,000,000
Total		42,000,000	62,000,000

TOWNSHIP 40 SOUTH, RANGE 14 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 40 S., R. 14 E., Oregon.

	Acres.
Forested area	3, 240
Nonforested area	19, 800

Total stand of timber in T. 40 S., R. 14 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	10, 000, 000	15, 000, 000

TOWNSHIP 40 SOUTH, RANGE 14½ EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 40 S., R. 14½ E., Oregon.

	Area.
Forested	13, 040
Nonforested	10, 000

Total stand of timber in T. 40 S., R. 14½ E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	39, 000, 000	45, 000, 000

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 2 WEST.

This fractional township comprises a portion of the summit of the Siskiyou Range near Sterling Peak, and the southern slopes therefrom. It includes a large amount of bare rocky summits and slopes naturally deforested.

The timber along the higher slopes is mostly composed of noble fir of large dimensions and often of very close stand. It is mixed with small percentages of white pine and red fir. The lower slopes carry yellow and sugar pine of medium quality. The larger proportion of the timber in the township is very difficult of access, and fire has marked it all.

Forested and other areas in T. 41 S., R. 2 W., Oregon.

	Acres.
Forested area	7,200
Nonforested area (rocks and glades)	3,000
Badly burned area	2,000
Logged area	None.

Total stand of timber in T. 41 S., R. 2 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	22.5	14,000,000	16,000,000
Sugar pine	8	5,000,000	5,000,000
White pine			3,000,000
Red fir	19.2	12,000,000	22,000,000
White fir			1,600,000
Noble fir	48.1	30,000,000	40,000,000
Incense cedar	2.1	1,300,000	1,500,000
Total		62,300,000	89,100,000

Composition of forest in T. 41 S., R. 2 W., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	20
Sugar pine	5
White pine	3
Red fir	25
White fir	5
Noble fir	40
Incense cedar	2

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 1 WEST.

This fractional township comprises spurs and canyons projecting southward from the Siskiyou Range.

Along the higher slopes the region is rocky and in part covered with light brush growth, in part with thin stands of forest.

The lower and intermediate slopes carry stands of good timber, the yellow pine and the sugar pine largely composed of veterans in good preservation. Fires have run throughout the township.

Forested and other areas in T. 41 S., R. 1 W., Oregon.

	Acres.
Forested area	9,000
Nonforested area (rocky summits, glades, etc.)	1,200
Badly burned area	1,000
Logged area	None.

Total stand of timber in T. 41 S., R. 1 W., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	65.7	50,000,000	60,000,000
Sugar pine	13.1	10,000,000	12,000,000
Red fir	19.9	15,000,000	28,000,000
White fir			3,000,000
Noble fir			5,000,000
Incense cedar	1.3	1,000,000	1,700,000
Total		76,000,000	109,700,000

Composition of forest in T. 41 S., R. 1 W., Oregon, including trees of all species with basal diamaters of 4 inches and upward.

	Per cent.
Yellow pine	52
Sugar pine	10
White pine	Scattered trees.
Red fir	28
White fir	1
Noble fir	5
Incense cedar	.5
Oak	3.5

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 1 EAST.

This fractional township consists of spurs and canyons projecting southward from the Siskiyou Range.

The forest along the lower slopes is of excellent quality and proportion, and is remarkable for the large percentage of incense cedar of large growth which it contains.

The upper slopes have been badly overrun by fires in recent times, and are thinly covered with forest in the midst of dense brush growths.

Forested and other areas in T. 41 S., R. 1 E., Oregon.

	Acres.
Forested area	9,900
Nonforested area	300
Badly burned area	1,500
Logged area (culled 80 per cent)	1,200

Total stand of timber in T. 41 S., R. 1 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	44	22,000,000	40,000,000
Sugar pine	30	15,000,000	15,000,000
Red fir	6	3,000,000	4,240,000
White fir	6	3,000,000	10,000,000
Incense cedar	14	7,000,000	8,000,000
Total	....	50,000,000	77,240,000

Composition of forest in T. 41 S., R. 1 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	65
Sugar pine	14
Red fir	5
White fir	10
Incense cedar	3
Oak	3

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 2 EAST.

The central and southern portions of this township are situated on the summit and southern slopes of the Siskiyou Range. The township is very thinly forested, consisting largely of grassy or brushy semiarid slopes. The northern portion of the township contains scattered stands of timber much damaged by fires and of little commercial value.

Forested and other areas in T. 41 S., R. 2 E., Oregon.

	Acres.
Forested area	8,200
Nonforested area (rocks, semiarid tracts, etc.)	2,000
Badly burned area	4,000
Logged area	None.

Total stand of timber in T. 41 S., R. 2 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	20	1,000,000	3,000,000
Sugar pine	40	2,000,000	2,000,000
Red fir	40	2,000,000	4,600,000
White fir	....	....	1,000,000
Total	....	5,000,000	10,600,000

Composition of forest in T. 41 S., R. 2 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	30
Sugar pine	2
Red fir	55
White fir	10

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 3 EAST.

This township consists of steep hills very sparsely forested, but covered with dense brush growths as the result of fires. Most of the timber was burned in recent times. There is no reforestation. The mill timber, scattered among the brush heaps, is of poor quality and practically inaccessible.

Forested and other areas in T. 41 S., R. 3 E., Oregon.

	Acres.
Forested area	7,000
Nonforested area (due to fires, 2,000)	3,200
Badly burned area	4,200
Logged area	None.

Total stand of timber in T. 41 S., R. 3 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	66.6	2,000,000	6,000,000
Red fir	33.4	1,000,000	4,000,000
Total		3,000,000	10,000,000

Composition of forest in T. 41 S., R. 3 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	60
Red fir	35
Sugar pine Incense cedar Oak	5

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 4 EAST.

The greater portion of this township consists of steep ridges bordering Jenny Creek, with a plateau-like tract in the northeastern area.

The southern areas of the township are timbered with light, open stands interspersed with many oak copses. The northern portions bear a forest of moderate density, easy of access, with stands of timber of good quality and body.

Forested and other areas in T. 41 S., R. 4 E., Oregon.

	Acres.
Forested area	7,800
Nonforested area (glades, meadows, rocks)	2,400
Badly burned area	800
Logged area	None.

Total stand of timber in T. 41 S., R. 4 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	66	33,000,000	42,000,000
Sugar pine	8	4,000,000	4,800,000
Red fir	24	12,000,000	17,800,000
White fir			400,000
Incense cedar	2	1,000,000	2,000,000
Total		50,000,000	67,000,000

Composition of forest in T. 41 S., R. 4 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	50
Sugar pine	5
Red fir	30
Incense cedar	2
White fir Western juniper	1
Oak	12

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 5 EAST.

This township consists of portion of the large lava plateau lying immediately north of the Klamath River and stretching northerly toward the volcanic areas south of Mount Pitt.

The region is well timbered with a massive, though open, forest. The pine is of excellent quality, long bodied, and composed mostly of large standards. Undergrowth is scanty and young growth is deficient, owing to frequently repeated fires. The Pokegama Lumber Company has here extensive logging camps.

Forested and other areas in T. 41 S., R. 5 E., Oregon.

	Acres.
Forested area	10,200
Logged area (culled 80 per cent)	2,000

Total stand of timber in T. 41 S., R. 5 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	51.2	40,000,000	50,000,000
Sugar pine	16.6	13,000,000	15,000,000
Red fir	32.2	25,000,000	30,000,000
White fir			4,000,000
Incense cedar			1,000,000
Total		78,000,000	100,000,000

Composition of forest in T. 41 S., R. 5 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	50
Sugar pine	10
Red fir	36
White fir Incense cedar	4

Fractional Township 41 South, Range 6 East.

The northern and western areas of the township consist chiefly of rocky and precipitous bluffs inclosing Klamath River Canyon. The eastern sections comprise portions of a plateau-like tract bordering the canyon on the south.

The bottom of the canyon is sparsely timbered, as are the slopes leading down into it. The plateau portion carries a heavy forest stand, which is broken by numerous small nonforested glades. The principal mill timber is yellow pine which is here of excellent quality and size. The red fir is mostly of small growth. Fire has marked the timber throughout the township.

Forested and other areas in T. 41 S., R. 6 E., Oregon.

	Acres.
Forested area	9,000
Nonforested area (rocky bluffs, glades, meadows)	1,200
Logged area	1,200

Total stand of timber in T. 41 S., R. 6 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	87	50,000,000	58,000,000
Red fir	13	8,000,000	29,500,000
Total		58,000,000	87,500,000

Composition of forest in T. 41 S., R. 6 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	45
Red fir	55

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 7 EAST.

This township comprises slopes of the divide which separates in part the waters of the Klamath River and those of Lower Klamath Lake. It is generally a steep and rocky region.

The yellow pine on the lower slopes is of good quality. Along the higher elevations it is largely replaced with red fir of small growth. The forest is fire seared throughout.

Forested and other areas in T. 41 S., R. 7 E., Oregon.

	Acres.
Forested area	9,200
Nonforested area (bare rocks and glades)	1,000
Badly burned area	1,300
Logged area	None.

Total stand of timber in T. 41 S., R. 7 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	88.6	62,000,000	78,000,000
Red fir	11.4	8,000,000	17,000,000
Total		70,000,000	95,000,000

Composition of forest in T. 41 S., R. 7 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	75
Red fir	25

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 8 EAST.

The eastern areas of the township consist of marshy tracts along Lower Klamath Lake. The western portions comprise rocky slopes forested with thin stands of yellow pine of inferior quality.

Forested and other areas in T. 41 S., R. 8 E., Oregon.

	Acres.
Forested area	2,800
Nonforested area (marsh)	8,320
Badly burned area	600
Logged area	None.

Total stand of timber in T. 41 S., R. 8 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	6,000,000	12,000,000
Red fir			2,000,000
Total		6,000,000	14,000,000

Composition of forest in T. 41 S., R. 8 E., Oregon, including trees of all species with basal diameters of 4 inches and upward.

	Per cent.
Yellow pine	98
Red fir	2

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 9 EAST.

This township is situated in Lower Klamath Lake and comprises marsh and lake areas. Its area is 11,520 acres, none of which is forested.

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 10 EAST.

The area of this township is 11,520 acres, none of which is forested.

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 11 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 41 S., R. 11 E., Oregon.

	Acres.
Forested area	800
Nonforested area	10,720

Total stand of timber in T. 41 S., R. 11 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			4,500,000

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 12 EAST.

There are no forest areas in this township. The area of the township is 11,520 acres.

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 13 EAST.

This township was not personally examined, but was estimated from information.

Forested and other areas in T. 41 S., R. 13 E., Oregon.

	Acres.
Forested area	8,520
Nonforested area	3,000

Total stand of timber in T. 41 S., R. 13 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	87.5	28,000,000	34,000,000
Red fir	12.5	4,000,000	7,000,000
White pine			3,000,000
Incense cedar			1,000,000
Total		32,000,000	45,000,000

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 14 EAST.

This township was not examined personally, but was estimated from information.

	Acres.
Forested area	11,520

Total stand of timber in T. 41 S., R. 14 E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine	100	45,000,000	55,000,000

FRACTIONAL TOWNSHIP 41 SOUTH, RANGE 14½ EAST.

The forest in this township consists chiefly of scattered stands of western juniper. The township was not personally examined, but was estimated from information.

Forested and other areas in T. 41 S., R. 14½ E., Oregon.

	Acres.
Forested area	3,500
Nonforested areas	8,020

Total stand of timber in T. 41 S., R. 14½ E., Oregon.

Species.	Local practice.		Michigan practice.
	Per cent.	*Feet B. M.*	*Feet B. M.*
Yellow pine			3,000,000

ASHLAND FOREST RESERVE, OREGON.

BOUNDARIES.

Beginning at the northeast corner of section twenty-seven (27), township thirty-nine (39) south, range one (1) east, Willamette meridian; thence westerly along the surveyed and unsurveyed section line to the northwest corner of section twenty-five (25), township thirty-nine (39) south, range one (1) west; thence southerly along the section line to the southwest corner of section thirty-six (36), said township and range; thence westerly along the ninth (9th) standard parallel south to the northwest corner of section one (1), township forty (40) south, range one (1) west; thence southerly along the section line to the southwest corner of section thirteen (13), said township and range; thence easterly along the surveyed and unsurveyed section line to the point for the southeast corner of section fourteen (14), township forty (40) south, range one (1) east; thence northerly along the surveyed and unsurveyed section line to the northeast corner of section thirty-five (35), township thirty-nine (39) south, range one (1) east; thence westerly to the northwest corner of said section thirty-five (35); thence northerly to the northeast corner of section twenty-seven (27), said township and range, the place of beginning.

DESCRIPTION OF RESERVE.

This reserve is carved out of T. 39 S., Rs. 1 W. and 1 E., and T. 40 S., Rs. 1 W. and 1 E. It contains between 22,000 and 23,000 acres, hence does not quite cover the area of one township. The object of this reserve is to maintain the stability of the water heads and to preserve the volume and purity of Ashland Creek, which furnishes the water supply to the town of Ashland, Oregon.

The reserve consists of Siskiyou Peak, or Ashland Butte, as the mountain is locally called, and spurs radiating from it. The peak is an elevation rising from the crest of the Siskiyou Range, and attains a height of nearly 8,000 feet above sea level. The actual peak rises about 800 feet above the general crest line of the range in this locality. The eastern and western slopes of the peak have an easy descent and blend gradually with the crest line. The southern declivities slope sharply toward the Klamath Valley. The northern slopes break away in precipitous escarpments to form the head of the Ashland Creek Basin. Long spurs stretch away from the peak toward the north. The spurs on the south side are short. One of the northern spurs, on which is situated Mount Wagner, maintains an altitude for the first 3 miles but slightly below that of the main Siskiyou Range. The others drop off in elevation very soon after leaving the vicinity of the peak.

A large amount of water flows out of the reserve. Most of it flows into Rogue River through Applegate, Wagner, and Ashland creeks. Another and smaller portion finds its way into Klamath River through various small creeks on the southern slope of the peak. Ashland Creek heads directly on the northern slopes of Siskiyou Peak. Snow lies at its head throughout the year. It empties into Bear

Creek one-half mile east of the town of Ashland. In addition to supplying water to this town, it furnishes irrigation for a number of fruit ranches, supplies motive power to one sawmill and one electric-light plant located above the town, one gristmill, one woollen mill, and a 5-stamp quartz mill located in the city, besides water for a cyanide reduction plant. It serves also in part as the town sewer. All in all, the stream is very important to the town.

The reserve contains no proper agricultural lands; the summits of the low spurs in the eastern areas might possibly be utilized for orchard purposes if cleared. Most if not the entire area is gold bearing. Quartz ledges occur in many places on the slopes of Siskiyou Peak and placer deposits exist, in all probability, near the head of the creeks. No mining is carried on inside the reserve area. The summit and slopes of Siskiyou Peak and the high northern Mount Wagner spur are grassy in many places. Sheep range here, or did the year before last. True, most of their runs had been on the slopes shedding water into Applegate Creek and Klamath River, but some had left their marks on the Ashland side. If the purity and stability of the water volume in Ashland Creek is worthy of consideration, the prohibition of sheep grazing within the reserve area should be absolute. A band of sheep confined to such a limited tract as the grazing area in Ashland Reserve soon makes the ground reek with most pestiferous exhalations,which can not but find their way into the running water.

The forest consists of stands of alpine-hemlock, red-fir, and yellow-pine types. The alpine-hemlock type occurs on the summit of the peak, and is composed almost wholly of noble fir. The others have the ordinary composition of their respective types elsewhere.

Fires have marked most of the forest, but have not burned in the reserve within the last ten or twelve years to any great extent, except on the summit of the range, at the base of the peak, where the timber on 300 or 400 acres has been almost totally destroyed.

The mill timber in the reserve is of good quality, except in the eastern portion, where fires, years ago, badly seared the most of it. It is generally difficult of access for logging operations. But whether easy or difficult of access, it is obvious that the maintenance of the Ashland Creek water volume is prohibitive to lumbering operations in the reserve.

The areal and timber estimates are as follows:

Forested and other areas in Ashland Forest Reserve, Oregon.

	Acres.
Area forested	20, 000
Area naturally nonforested	1, 700
Area deforested by fires of modern date	300

Total stand of mill timber in Ashland Forest Reserve, Oregon.

	Feet B. M.
Yellow pine	30, 000, 000
Sugar pine	12, 000, 000
Red fir	100, 000, 000
White fir	6, 000, 000
Noble fir	50, 000, 000
Incense cedar	2, 000, 000
	200, 000, 000

SUMMARY OF AREAL AND TIMBER ESTIMATES.

SUMMARY OF CASCADE RANGE FOREST RESERVE, OREGON.

Area examined in the Cascade Range Forest Reserve, Oregon.

	Acres.
Area nonforested	210, 780
Area forested	627, 620
Total	838, 400
Area badly burned	305, 120

Total stand of mill timber in Cascade Range Forest Reserve, Oregon.

	Feet B. M.
Yellow pine	625, 903, 800
Sugar pine	84, 617, 300
White pine	100, 370, 500
Red fir	1, 952, 338, 600
White fir	567, 553, 600
Noble fir	692, 324, 400
Incense cedar	7, 393, 600
Alpine hemlock	590, 699, 800
Western hemlock	20, 938, 200
Engelmann spruce	68, 969, 400
Total	4, 711, 109, 200

Average stand of mill timber per forested acre, 7, 506.

Areas classed as "badly burned" consist of tracts on which the forest has been burned from 75 per cent and upward by fires whose origin lie within the time of the white man's occupancy of the region. Seventy per cent of the areas thus devastated by fire are covered with brush growths or, to a lesser extent, with low-growing mountain sedges, the "grass" of the sheep ranges, of low nutritive value. The latter tracts are slowly reforesting; the former are not. The tracts marked by fires during the past forty or forty-five years comprise in the aggregate 820,000 acres.

Nonforested tracts include areas naturally nonforested and such as have been deforested by fire. Forested areas include veteran, standard, and young growth stands, together with reforestations advanced to sapling stage and thinly wooded subalpine areas.

Areal and timber estimates of the Cascade Range Forest Reserve, Oregon.

T.	R.	Non-forested.	Forested.	Badly burned.	Yellow pine.	Sugar pine.	White pine.
		Acres.	*Acres.*	*Acres.*	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
28 S.	5 E.		23,040	18,000			5,000,000
28 S.	6 E.	5,040	18,000	15,000			
28 S.	6½ E.		16,000	8,500	80,000,000		
29 S.	3 E.		23,040	10,000			4,000,000
29 S.	4 E.		23,040	18,000			5,000,000
29 S.	5 E.		23,040	18,000			
30 S.	1 E.		23,040	2,500	59,685,000	7,958,000	
30 S.	2 E.	2,000	21,040	3,500	25,654,400	16,896,000	3,379,200
30 S.	3 E.	3,360	19,680	6,000	9,348,000	11,686,000	4,674,000
30 S.	4 E.	3,300	19,740	3,300	4,309,200	1,077,300	1,077,300
30 S.	5 E.	10,180	12,860	6,500	1,300,000	700,000	
30 S.	6 E.	17,960	5,080	2,500			
30 S.	6½ E.	2,000	21,040	5,000	52,000,000		
31 S.	1 E.		23,040	7,000	16,500,000	3,000,000	
31 S.	2 E.		23,040	8,500	23,467,200	9,850,000	
31 S.	3 E.	12,160	10,880	15,000	8,000,000	9,000,000	1,000,000
31 S.	4 E.	8,320	14,720	8,320	1,000,000	1,000,000	6,000,000
31 S.	5 E.	2,560	20,480	4,000	200,000		
31 S.	6 E.	1,600	21,440	4,000			5,000,000
32 S.	4 E.	13,000	10,040	13,000			5,000,000
32 S.	5 E.	11,600	11,440	11,000			1,900,000
32 S.	6 E.	2,600	20,440	5,000	65,000,000		3,000,000
33 S.	4 E.	9,900	13,140	11,000	1,000,000	6,500,000	
33 S.	5 E.	6,500	16,540	9,500			
33 S.	6 E.	10,100	12,940	8,000	8,000,000	3,000,000	2,000,000
34 S.	4 E.	7,700	15,340	8,000	6,500,000		
34 S.	5 E.	3,900	19,140	8,500			
34 S.	6 E.	9,600	13,440	4,000	20,000,000		1,540,000
35 S.	4 E.	10,800	12,240	12,000	69,000,000		
35 S.	5 E.	6,400	16,640	8,000			
35 S.	6 E.	6,300	16,740	5,000	38,000,000	2,650,000	500,000
36 S.	4 E.	7,000	16,040	3,500	10,000,000	2,000,000	8,500,000
36 S.	5 E.	10,200	12,840	12,000	3,000,000		12,000,000
36 S.	6 E.	7,200	15,840	5,500	110,000,000	8,300,000	
37 S.	4 E.	4,100	18,940	4,500	940,000		18,000,000
37 S.	5 E.	6,400	16,640	7,000	2,000,000		12,000,000
37 S.	6 E.	9,000	14,040	6,000	11,000,000	1,000,000	800,000

Areal and timber estimates of the Cascade Range Forest Reserve, Oregon—Continued.

T.	R.	Red fir.	White fir.	Noble fir.	Incense cedar.
		Feet B. M.	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
28 S..	5 E..			25,000,000	
28 S..	6 E..			3,000,000	
28 S..	6½ E.				
29 S..	3 E..	40,000,000	10,000,000		
29 S..	4 E..	10,000,000	10,000,000		
29 S..	5 E..				
30 S..	1 E..	250,677,000	7,958,000	39,790,000	
30 S..	2 E..	209,889,600	3,379,200	41,550,400	1,689,600
30 S..	3 E..	140,232,000	23,372,000	35,058,000	700,000
30 S..	4 E..	150,822,000	30,164,400	21,546,000	
30 S..	5 E..	5,000,000		4,000,000	
30 S..	6 E..			3,000,000	
30 S..	6½ E.		3,000,000	5,600,000	
31 S..	1 E..	160,000,000	8,000,000	11,000,000	620,000
31 S..	2 E..	205,338,000	6,000,000	14,000,000	1,684,000
31 S..	3 E..	150,000,000	12,000,000	2,000,000	
31 S..	4 E..	4,200,000		98,000,000	600,000
31 S..	5 E..	680,000		20,000,000	
31 S..	6 E..		5,000,000	15,000,000	
32 S..	4 E..			90,000,000	
32 S..	5 E..			14,000,000	
32 S..	6 E..		30,000,000	1,480,000	
33 S..	4 E..	108,000,000	12,480,000		
33 S..	5 E..			14,300,000	
33 S..	6 E..	1,000,000	10,000,000	5,000,000	
34 S..	4 E..	13,000,000	2,800,000	25,000,000	
34 S..	5 E..			10,000,000	
34 S..	6 E..	8,500,000	38,000,000	25,000,000	
35 S..	4 E..	42,000,000	2,750,000	15,000,000	
35 S..	5 E..		6,450,000	14,000,000	
35 S..	6 E..	20,000,000	30,000,000	15,000,000	
36 S..	4 E..	148,000,000	27,000,000	37,000,000	
36 S..	5 E..	36,000,000	60,700,000	13,000,000	
36 S..	6 E..	35,000,000	20,000,000		2,100,000
37 S..	4 E..	180,000,000	48,500,000	26,000,000	
37 S..	5 E..	30,000,000	120,000,000	16,000,000	
37 S..	6 E..	4,000,000	40,000,000	33,000,000	

Areal and timber estimates of the Cascade Range Forest Reserve, Oregon—Continued.

T.	R.	Alpine hemlock.	Western hemlock.	Engelmann spruce.	Total.
		Feet B. M.	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
28 S..	5 E..	10,000,000	...	...	40,000,000
28 S..	6 E..	2,000,000	...	...	5,000,000
28 S..	6½ E.	...	...	...	80,000,000
29 S..	3 E..	11,000,000	...	...	65,000,000
29 S..	4 E..	...	...	...	25,000,000
29 S..	5 E..	...	...	...	...
30 S..	1 E..	31,832,000	...	...	397,900,000
30 S..	2 E..	33,792,000	1,689,600	...	337,920,000
30 S..	3 E..	7,012,000	1,168,600	469,400	233,720,000
30 S..	4 E..	6,463,800	...	...	215,460,000
30 S..	5 E..	14,040,000	...	...	25,040,000
30 S..	6 E..	10,000,000	...	440,000	13,440,000
30 S..	6½ E.	7,000,000	...	...	67,600,000
31 S..	1 E..	14,000,000	...	...	213,120,000
31 S..	2 E..	33,000,000	...	...	293,339,200
31 S..	3 E..	1,200,000	480,000	...	183,680,000
31 S..	4 E..	13,400,000	8,000,000	...	132,200,000
31 S..	5 E..	36,000,000	...	...	56,880,000
31 S..	6 E..	25,000,000	...	520,000	50,520,000
32 S..	4 E..	7,960,000	3,000,000	...	105,960,000
32 S..	5 E..	52,000,000	600,000	460,000	68,960,000
32 S..	6 E..	10,000,000	...	...	109,480,000
33 S..	4 E..	...	...	...	127,980,000
33 S..	5 E..	108,000,000	...	2,000,000	124,300,000
33 S..	6 E..	23,000,000	...	400,000	52,400,000
34 S..	4 E..	40,000,000	...	21,000,000	108,300,000
34 S..	5 E..	17,000,000	...	4,280,000	31,280,000
34 S..	6 E..	9,000,000	...	8,000,000	110,040,000
35 S..	4 E..	6,000,000	...	...	134,750,000
35 S..	5 E..	15,000,000	...	17,000,000	52,450,000
35 S..	6 E..	6,000,000	...	500,000	112,650,000
36 S..	4 E..	13,000,000	1,500,000	1,000,000	248,000,000
36 S..	5 E..	10,000,000	2,000,000	3,000,000	139,700,000
36 S..	6 E..	...	...	...	175,400,000
37 S..	4 E..	...	...	3,500,000	276,940,000
37 S..	5 E..	3,000,000	2,500,000	400,000	185,900,000
37 S..	6 E..	15,000,000	...	6,000,000	110,800,000

SUMMARY OF AREAL AND TIMBER ESTIMATES FOR ENTIRE REGION EXAMINED.

Forested and other areas in region examined.

	Acres.
Forested area	2,998,440
Nonforested area	1,677,920
Total	4,676,360

Amount of timber examined and estimated.

	Feet B. M.
Yellow pine	9,477,520,400
Sugar pine	813,902,100
White pine	130,470,500
Red fir	6,638,264,800
White fir	1,215,526,000
Noble fir	885,824,400
Incense cedar	91,393,600
Alpine hemlock	609,619,800
Western hemlock	46,718,200
Engelmann spruce	71,969,400
Total	19,981,209,200

Average of mill timber per forested acre, 6,664.

These estimates are based upon dimensions down to 8 inches basal diameter and 10 feet of clear trunk. Close and economical lumbering methods utilizing portions of the crown would add 15 per cent to above timber estimates.

The rather low average per forested acre is due to the occurrence on the summit and eastern slope of the Cascades of large forested areas covered with a nearly pure growth of lodgepole pine or in some localities at high elevations of tracts with stands of scrubby alpine hemlock. Areas of these kinds carry no mill timber.

The large tracts of nonforested lands in the region are due to: (1) semiarid valleys occurring not only on the eastern slope of the Cascades where the annual precipitation is low, but also on the western declivities of the range; (2) large brush-covered areas on the summit and western slopes of the Cascades and on the summit and northern and southern slopes of the Siskiyous. They are the result of extensive fires destroying the timber and nonreforestation. Considerable tracts also are covered by the large Klamath lakes and their borders of grass and tule lands.

Areal and timber estimates, by townships, of region examined.

T.	R.	Nonforested.	Forested.	Yellow pine.	Sugar pine.	White pine.
		Acres.	*Acres.*	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
28 S	5 E		23,040			5,000,000
28 S	6 E	5,040	18,000			
28 S	6½ E		23,040	161,280,000		
28 S	7 E		23,040	26,880,000		
28 S	8 E		23,040	1,500,000		
29 S	3 E		23,040			4,000,000
29 S	4 E		23,040			5,000,000
29 S	5 E		23,040			
29 S	7 E		23,040	80,640,000		
29 S	8 E	3,040	20,000	6,000,000		
30 S	1 E		23,040	59,685,000	7,958,000	
30 S	2 E	2,000	21,040	25,654,400	16,896,000	3,379,200
30 S	3 E	3,360	19,680	9,348,000	11,686,000	4,674,000
30 S	4 E	3,300	19,740	4,309,200	1,077,300	1,077,300
30 S	5 E	10,180	12,860	1,300,000	700,000	
30 S	6 E	17,960	5,080			
30 S	6½ E	2,000	21,040	52,000,000		
30 S	7 E	18,560	4,480	33,600,000		
30 S	8 E	5,760	17,280	2,240,000		
30 S	9 E	16,640	6,400	26,240,000		
30 S	10 E	11,240	11,800	122,700,000		
30 S	11 E	7,700	15,340	93,700,000		
30 S	12 E	12,000	11,040	35,000,000		
30 S	13 E	15,000	8,040	16,000,000		
30 S	14 E	13,000	10,040	8,000,000		
31 S	1 W		23,040	85,000,000	10,000,000	
31 S	1 E		23,040	16,500,000	3,000,000	
31 S	2 E		23,040	23,467,200	9,850,000	
31 S	3 E	12,160	10,880	8,000,000	9,000,000	1,000,000
31 S	4 E	8,320	14,720	1,000,000	1,000,000	6,000,000
31 S	5 E	2,560	20,480	200,000		
31 S	6 E	1,600	21,440			5,000,000
31 S	6½ E	2,000	21,040	65,000,000		
31 S	7 E	3,040	20,000	71,500,000		
31 S	8 E	17,400	5,640			
31 S	9 E	8,300	14,740	76,160,000		
31 S	10 E		23,040	220,800,000		
31 S	11 E	3,900	19,140	200,000,000		

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Red fir.	White fir.	Noble fir.	Incense cedar.
		Feet B. M.	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
28 S	5 E			25,000,000	
28 S	6 E			3,000,000	
28 S	6½ E				
28 S	7 E				
28 S	8 E				
29 S	3 E	40,000,000	10,000,000		
29 S	4 E	10,000,000	10,000,000		
29 S	5 E				
29 S	7 E				
29 S	8 E				
30 S	1 E	250,677,000	7,958,000	39,790,000	
30 S	2 E	209,889,600	3,379,200	41,550,400	1,689,600
30 S	3 E	140,232,000	23,372,000	35,058,000	700,000
30 S	4 E	150,822,000	30,164,400	21,546,000	
30 S	5 E	5,000,000		4,000,000	
30 S	6 E			3,000,000	
30 S	6½ E		3,000,000	5,600,000	
30 S	7 E				
30 S	8 E				
30 S	9 E				
30 S	10 E				
30 S	11 E		3,740,000		
30 S	12 E				
30 S	13 E				
30 S	14 E				
31 S	1 W	175,000,000	25,000,000		5,000,000
31 S	1 E	160,000,000	8,000,000	11,000,000	620,000
31 S	2 E	205,338,000	6,000,000	14,000,000	1,684,000
31 S	3 E	150,000,000	12,000,000	2,000,000	
31 S	4 E	4,200,000		98,000,000	600,000
31 S	5 E			20,000,000	
31 S	6 E		5,000,000	15,000,000	
31 S	6½ E		1,000,000	5,000,000	
31 S	7 E		500,000		
31 S	8 E				
31 S	9 E				
31 S	10 E				
31 S	11 E		2,900,000		

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Alpine hemlock.	Western hemlock.	Engelmann spruce.	Total.
		Feet B. M.	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
28 S.	5 E.	10,000,000			40,000,000
28 S.	6 E.	2,000,000			5,000,000
28 S.	6½ E.				161,280,000
28 S.	7 E.				26,880,000
28 S.	8 E.				1,500,000
29 S.	3 E.	11,000,000			65,000,000
29 S.	4 E.				25,000,000
29 S.	5 E.				
29 S.	7 E.				80,640,000
29 S.	8 E.				6,000,000
30 S.	1 E.	31,832,000			397,900,000
30 S.	2 E.	33,792,000	1,689,600		337,920,000
30 S.	3 E.	7,012,000	1,168,600	469,400	233,720,000
30 S.	4 E.	6,463,800			215,460,000
30 S.	5 E.	14,040,000			25,040,000
30 S.	6 E.	10,000,000		440,000	13,440,000
30 S.	6½ E.	7,000,000			67,600,000
30 S.	7 E.				33,600,000
30 S.	8 E.				2,240,000
30 S.	9 E.				26,240,000
30 S.	10 E.				122,700,000
30 S.	11 E.				97,440,000
30 S.	12 E.				35,000,000
30 S.	13 E.				16,000,000
30 S.	14 E.				8,000,000
31 S.	1 W.				300,000,000
31 S.	1 E.	14,000,000			213,120,000
31 S.	2 E.	33,000,000			293,339,200
31 S.	3 E.	1,200,000	480,000		183,680,000
31 S.	4 E.	13,400,000	8,000,000		132,200,000
31 S.	5 E.	36,000,000			56,880,000
31 S.	6 E.	25,000,000		520,000	50,520,000
31 S.	6½ E.	27,920,000			98,920,000
31 S.	7 E.				72,000,000
31 S.	8 E.				
31 S.	9 E.				76,160,000
31 S.	10 E.				220,800,000
31 S.	11 E.				202,900,000

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Nonforested.	Forested.	Yellow pine.	Sugar pine.	White pine.
		Acres.	*Acres.*	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
31 S....	12 E...	8,000	15,040	25,000,000	....	....
31 S....	13 E...	12,000	11,040	12,000,000	....	....
31 S....	14 E...	12,000	11,040	48,000,000	....	....
32 S....	2 W..	600	22,440	15,000,000	6,000,000	....
32 S....	1 W..	1,200	21,840	30,000,000	8,000,000	....
32 S....	1 E...	....	23,040	48,000,000	800,000	....
32 S....	2 E...	4,500	18,540	54,000,000	6,000,000	....
32 S....	3 E...	5,100	17,940	45,000,000	100,000,000	6,000,000
32 S....	4 E...	13,000	10,040	....	....	5,000,000
32 S....	5 E...	11,600	11,440	....	....	1,900,000
32 S....	6 E...	2,600	20,440	65,000,000	....	3,000,000
32 S....	7½ E..	6,400	16,640	65,000,000	5,000,000	....
32 S....	7 E...	2,000	20,540	160,480,000	9,440,000	....
32 S....	8 E...	4,800	18,240	34,560,000	....	....
32 S....	9 E...	9,040	14,000	98,000,000	....	....
32 S....	10 E...	3,000	23,040	154,800,000	....	....
32 S....	11 E...	7,700	15,340	88,000,000	....	....
32 S....	12 E...	....	23,040	197,800,000	....	....
32 S....	13 E...	9,000	14,040	91,500,000	....	....
32 S....	14 E...	10,000	13,040	32,000,000	....	....
33 S....	2 W..	1,000	22,040	40,000,000	....	....
33 S....	1 W..	2,800	20,240	60,000,000	3,000,000	....
33 S....	1 E...	4,400	18,640	20,520,000	3,000,000	....
33 S....	2 E...	2,500	20,540	24,000,000	4,600,000	....
33 S....	3 E...	3,200	19,840	16,000,000	99,500,000	6,000,000
33 S....	4 E...	9,900	13,140	1,000,000	6,500,000	....
33 S....	5 E...	6,500	16,540	....	....	....
33 S....	6 E...	10,100	12,940	8,000,000	3,000,000	2,000,000
33 S....	7½ E..	14,000	9,040	29,000,000	5,000,000	....
33 S....	7 E...	1,600	21,440	197,820,000	2,000,000	....
33 S....	8 E...	600	22,440	147,980,000	....	....
33 S....	9 E...	6,100	16,940	101,800,000	....	....
33 S....	10 E...	200	22,840	250,600,000	....	....
33 S....	11 E...	1,300	21,740	131,800,000	....	....
33 S....	12 E...	2,000	21,040	53,000,000	....	....
33 S....	13 E...	7,000	16,040	24,000,000	....	....
33 S....	14 E...	10,000	13,040	10,000,000	....	....
34 S....	2 W..	2,000	21,040	16,000,000	1,500,000	....
34 S....	1 W..	2,500	20,540	12,000,000	....	....

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Red fir.	White fir.	Noble fir.	Incense cedar.
		Feet B. M.	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
31 S	12 E				
31 S	13 E				
31 S	14 E				
32 S	2 W	175,000,000	12,000,000		1,000,000
32 S	1 W	195,000,000	13,000,000		2,000,000
32 S	1 E	190,000,000	8,000,000		440,000
32 S	2 E	110,000,000	10,000,000		1,120,000
32 S	3 E	286,000,000	12,240,000		
32 S	4 E			90,000,000	
32 S	5 E			14,000,000	
32 S	6 E		30,000,000	1,480,000	
32 S	7½ E		15,000,000		300,000
32 S	7 E		18,880,000		
32 S	8 E				
32 S	9 E				
32 S	10 E				
32 S	11 E				
32 S	12 E				
32 S	13 E				
32 S	14 E				
33 S	2 W	11,000,000			
33 S	1 W	47,000,000			
33 S	1 E	33,000,000	1,500,000		500,000
33 S	2 E	156,000,000	16,000,000		800,000
33 S	3 E	610,500,000	65,000,000		3,000,000
33 S	4 E	108,000,000	12,480,000		
33 S	5 E			14,300,000	
33 S	6 E	1,000,000	10,000,000	5,000,000	
33 S	7½ E	100,000	7,450,000		850,000
33 S	7 E		4,000,000		500,000
33 S	8 E				
33 S	9 E				
33 S	10 E				
33 S	11 E				
33 S	12 E				
33 S	13 E				
33 S	14 E				
34 S	2 W	5,000,000			500,000
34 S	1 W	4,000,000			

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Alpine hemlock.	Western hemlock.	Engelmann spruce.	Total.
		Feet B. M.	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
31 S	12 E				25, 000, 000
31 S	13 E				12, 000, 000
31 S	14 E				48, 000, 000
32 S	2 W				209, 000, 000
32 S	1 W				248, 000, 000
32 S	1 E				247, 240, 000
32 S	2 E				181, 120, 000
32 S	3 E		3, 000, 000		452, 240, 000
32 S	4 E	7, 960, 000	3, 000, 000		105, 960, 000
32 S	5 E	52, 000, 000	600, 000	460, 000	68, 960, 000
32 S	6 E	10, 000, 000			109, 480, 000
32 S	7½ E				85, 300, 000
32 S	7 E				188, 800, 000
32 S	8 E				34, 560, 000
32 S	9 E				98, 000, 000
32 S	10 E				154, 800, 000
32 S	11 E				88, 000, 000
32 S	12 E				197, 800, 000
32 S	13 E				91, 500, 000
32 S	14 E				32, 000, 000
33 S	2 W				51, 000, 000
33 S	1 W				110, 000, 000
33 S	1 E				58, 520, 000
33 S	2 E		2, 400, 000		203, 800, 000
33 S	3 E		6, 880, 000		806, 880, 000
33 S	4 E				127, 980, 000
33 S	5 E	108, 000, 000		2, 000, 000	124, 300, 000
33 S	6 E	23, 000, 000		400, 000	52, 400, 000
33 S	7½ E				42, 400, 000
33 S	7 E				204, 320, 000
33 S	8 E				147, 980, 000
33 S	9 E				101, 800, 000
33 S	10 E				250, 600, 000
33 S	11 E				131, 800, 000
33 S	12 E				53, 000, 000
33 S	13 E				24, 000, 000
33 S	14 E				10, 000, 000
34 S	2 W				23, 000, 000
34 S	1 W				16, 000, 000

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Nonforested.	Forested.	Yellow pine.	Sugar pine.	White pine.
		Acres.	*Acres.*	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
34 S.	1 E.	6,400	16,640	12,000,000	3,480,000	....
34 S.	2 E.	3,800	19,240	34,000,000	12,000,000	....
34 S.	3 E.	2,500	20,540	90,000,000	24,000,000	....
34 S.	4 E.	7,700	15,340	6,500,000	....	....
34 S.	5 E.	3,900	19,140	....	....	....
34 S.	6 E.	9,600	13,440	20,000,000	....	1,540,000
34 S.	7½ E.	21,840	1,200	3,600,000	....	....
34 S.	7 E.	5,760	17,280	48,000,000	3,000,000	....
34 S.	8 E.	10,880	12,160	28,400,000	700,000	....
34 S.	9 E.	10,240	12,800	30,000,000	....	....
34 S.	10 E.	....	23,040	70,000,000	....	....
34 S.	11 E.	8,000	15,040	77,300,000	....	....
34 S.	12 E.	9,200	13,840	94,000,000	700,000	....
34 S.	13 E.	....	23,040	147,000,000	3,000,000	....
34 S.	14 E.	8,000	15,040	40,000,000	1,500,000	....
35 S.	2 W.	20,040	3,000	1,600,000	....	....
35 S.	1 W.	18,040	5,000	3,000,000	....	....
35 S.	1 E.	12,800	10,240	14,000,000	....	....
35 S.	2 E.	3,200	19,840	28,000,000	4,500,000	....
35 S.	3 E.	3,000	20,040	160,000,000	11,000,000	....
35 S.	4 E.	10,800	12,240	69,000,000	....	....
35 S.	5 E.	6,400	16,640	....	....	....
35 S.	6 E.	6,300	16,740	38,000,000	2,650,000	500,000
35 S.	7½ E.	23,040	....	....	....	....
35 S.	7 E.	7,680	15,360	40,320,000	....	....
35 S.	8 E.	....	23,040	59,296,600	2,764,800	....
35 S.	9 E.	7,700	15,340	73,000,000	1,000,000	....
35 S.	10 E.	10,880	12,160	6,000,000	....	....
35 S.	11 E.	16,700	6,340	3,200,000	....	....
35 S.	12 E.	18,800	4,240	17,300,000	....	....
35 S.	13 E.	6,100	16,940	48,000,000	3,000,000	....
35 S.	14 E.	15,000	8,040	22,000,000	....	....
36 S.	2 W.	18,840	4,200	2,300,000	....	....
36 S.	1 W.	18,040	5,000	2,700,000	....	....
36 S.	1 E.	13,640	9,400	4,800,000	....	....
36 S.	2 E.	7,000	16,040	12,000,000	3,000,000	....
36 S.	3 E.	3,600	19,440	50,000,000	4,500,000	6,000,000
36 S.	4 E.	7,000	16,040	10,000,000	2,000,000	8,500,000
36 S.	5 E.	10,200	12,840	3,000,000	....	12,000,000

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Red fir.	White fir.	Noble fir.	Incense cedar.
		Feet B. M.	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
34 S....	1 E...	15,410,000	3,910,000	....	....
34 S....	2 E...	118,000,000	10,000,000	....	1,690,000
34 S....	3 E...	234,000,000	38,000,000	....	5,360,000
34 S....	4 E...	13,000,000	2,800,000	25,000,000	....
34 S....	5 E...	....	....	10,000,000	....
34 S....	6 E...	8,500,000	38,000,000	25,000,000	....
34 S....	7½ E..	....	....	....	....
34 S....	7 E...	....	2,000,000	....	240,000
34 S....	8 E...	....	1,300,000	....	....
34 S....	9 E...	....	....	....	....
34 S....	10 E...	....	....	....	....
34 S....	11 E...	....	1,700,000	....	....
34 S....	12 E...	....	1,200,000	....	100,000
34 S....	13 E...	....	17,000,000	....	1,000,000
34 S....	14 E...	....	8,000,000	....	500,000
35 S....	2 W..	700,000	....	....	....
35 S....	1 W..	1,000,000	....	....	....
35 S....	1 E...	8,000,000	2,000,000	....	....
35 S....	2 E...	98,000,000	11,000,000	....	3,600,000
35 S....	3 E...	109,000,000	12,000,000	....	3,000,000
35 S....	4 E...	42,000,000	2,750,000	15,000,000	....
35 S....	5 E...	....	6,450,000	14,000,000	....
35 S....	6 E...	20,000,000	30,000,000	15,000,000	....
35 S....	7½ E..	....	....	....	....
35 S....	7 E...	....	....	....	....
35 S....	8 E...	5,776,200	1,382,400	....	....
35 S....	9 E...	4,000,000	2,000,000	....	....
35 S....	10 E...	....	....	....	....
35 S....	11 E...	....	....	....	....
35 S....	12 E...	....	....	....	....
35 S....	13 E...	....	6,000,000	....	600,000
35 S....	14 E...	....	6,000,000	....	....
36 S....	2 W..	200,000	....	....	....
36 S....	1 W..	300,000	....	....	....
36 S....	1 E...	500,000	....	....	....
36 S....	2 E...	22,000,000	3,000,000	....	1,000,000
36 S....	3 E...	160,000,000	25,000,000	10,500,000	2,500,000
36 S....	4 E...	148,000,000	27,000,000	37,000,000	....
36 S....	5 E...	36,000,000	60,700,000	13,000,000	....

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Alpine hemlock.	Western hemlock.	Engelmann spruce.	Total.
		Feet B. M.	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
34 S.	1 E.				34,800,000
34 S.	2 E.		1,000,000		176,690,000
34 S.	3 E.		1,000,000		392,360,000
34 S.	4 E.	40,000,000		21,000,000	108,300,000
34 S.	5 E.	17,000,000		4,280,000	31,280,000
34 S.	6 E.	9,000,000		8,000,000	110,040,000
34 S.	7½ E.				3,600,000
34 S.	7 E.				53,240,000
34 S.	8 E.				30,400,000
34 S.	9 E.				30,000,000
34 S.	10 E.				70,000,000
34 S.	11 E.				79,000,000
34 S.	12 E.				96,000,000
34 S.	13 E.				168,000,000
34 S.	14 E.				50,000,000
35 S.	2 W.				2,300,000
35 S.	1 W.				4,000,000
35 S.	1 E.				24,000,000
35 S.	2 E.				145,100,000
35 S.	3 E.				295,000,000
35 S.	4 E.	6,000,000			134,750,000
35 S.	5 E.	15,000,000		17,000,000	52,450,000
35 S.	6 E.	6,000,000		500,000	112,650,000
35 S.	7½ E.				
35 S.	7 E.				40,320,000
35 S.	8 E.				69,220,000
35 S.	9 E.				80,000,000
35 S.	10 E.				6,000,000
35 S.	11 E.				3,200,000
35 S.	12 E.				17,300,000
35 S.	13 E.				57,600,000
35 S.	14 E.				28,000,000
36 S.	2 W.				2,500,000
36 S.	1 W.				3,000,000
33 S.	1 E.				5,300,000
36 S.	2 E.				41,000,000
36 S.	3 E.				258,500,000
36 S.	4 E.	13,000,000	1,500,000	1,000,000	248,000,000
36 S.	5 E.	10,000,000	2,000,000	3,000,000	139,700,000

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Nonforested.	Forested.	Yellow pine.	Sugar pine.	White pine.
		Acres.	*Acres.*	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
36 S....	6 E...	7, 200	15, 840	110, 000, 000	8, 300, 000	....
36 S....	7a E..	20, 040	3, 000	2, 500, 000	....	....
36 S....	7b E..	15, 760	7, 280	21, 640, 000	....	....
36 S....	8 E...	....	23, 040	72, 000, 000	2, 000, 000	....
36 S....	9 E...	1, 200	21, 840	110, 500, 000	1, 300, 000	....
36 S....	10 E...	12, 800	10, 240	38, 000, 000	....	....
36 S....	11 E...	15, 360	7, 680	64, 000, 000	....	....
36 S....	12 E...	20, 540	2, 500	2, 500, 000	....	....
36 S....	13 E...	7, 000	16, 040	113, 000, 000	....	....
36 S....	14 E...	15, 000	8, 040	8, 000, 000	....	....
37 S....	2 W..	20, 640	2, 400	800, 000	....	....
37 S....	1 W..	13, 500	9, 540	9, 000, 000	1, 000, 000	....
37 S....	1 E...	1, 900	21, 140	18, 000, 000	500, 000	....
37 S....	2 E...	3, 000	20, 040	35, 000, 000	1, 700, 000	....
37 S....	3 E...	3, 500	19, 540	54, 000, 000	5, 600, 000	....
37 S....	4 E...	4, 100	18, 940	940, 000	....	18, 000, 000
37 S....	5 E...	6, 400	16, 640	2, 000, 000	....	12, 000, 000
37 S....	6 E...	9, 000	14, 040	11, 000, 000	1, 000, 000	800, 000
37 S....	7 E...	3, 900	19, 140	135, 800, 000	....	....
37 S....	8 E...	22, 340	700	1, 400, 000	....	....
37 S....	9 E...	12, 160	10, 880	40, 320, 000	....	....
37 S....	10 E...	16, 160	6, 880	32, 000, 000	400, 000	....
37 S....	11½ E..	14, 720	8, 320	18, 500, 000	....	....
37 S....	11 E...	3, 840	19, 200	57, 600, 000	....	....
37 S....	12 E...	2, 900	20, 140	94, 000, 000	....	....
37 S....	13 E...	2, 600	20, 440	95, 000, 000	....	....
37 S....	14 E...	6, 000	17, 040	42, 000, 000	....	....
38 S....	2 W..	5, 200	17, 840	30, 000, 000	....	....
38 S....	1 W..	23, 040	....	....	....	....
38 S....	1 E...	11, 600	11, 440	22, 000, 000	....	....
38 S....	2 E...	11, 000	12, 040	11, 000, 000	....	....
38 S....	3 E...	5, 700	17, 340	55, 000, 000	3, 000, 000	....
38 S....	4 E...	5, 700	17, 340	44, 000, 000	8, 000, 000	5, 900, 000
38 S....	5 E...	6, 000	17, 040	45, 000, 000	2, 000, 000	1, 200, 000
38 S....	6 E...	3, 600	19, 440	64, 000, 000	22, 000, 000	3, 000, 000
38 S....	7 E...	4, 500	18, 540	118, 000, 000	....	....
38 S....	8 E...	17, 280	5, 760	14, 300, 000	....	....
38 S....	9 E...	17, 280	5, 760	11, 520, 000	....	....
38 S....	10 E...	12, 160	10, 880	22, 000, 000	....	....

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Red fir.	White fir.	Noble fir.	Incense cedar.
		Feet B. M.	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
36 S	6 E	35,000,000	20,000,000	...	2,100,000
36 S	7a E	500,000	...	...	...
36 S	7b E	...	...	...	...
36 S	8 E	4,000,000	5,000,000	...	1,280,000
36 S	9 E	12,200,000	9,500,000	...	2,500,000
36 S	10 E	...	2,000,000	...	500,000
36 S	11 E	...	2,200,000	...	300,000
36 S	12 E	...	300,000	...	...
36 S	13 E	...	...	...	...
36 S	14 E	...	...	...	...
37 S	2 W	400,000	...	...	...
37 S	1 W	15,000,000	5,000,000	...	400,000
37 S	1 E	12,000,000	1,500,000	...	...
37 S	2 E	60,000,000	4,000,000	...	...
37 S	3 E	130,000,000	4,000,000	...	...
37 S	4 E	180,000,000	48,500,000	26,000,000	...
37 S	5 E	30,000,000	120,000,000	16,000,000	...
37 S	6 E	4,000,000	40,000,000	33,000,000	...
37 S	7 E	10,000,000	24,000,000	...	...
37 S	8 E	...	...	...	...
37 S	9 E	...	...	...	...
37 S	10 E	5,000,000	5,000,000	...	700,000
37 S	11½ E	...	...	...	...
37 S	11 E	...	...	...	...
37 S	12 E	...	6,000,000	...	...
37 S	13 E	...	...	...	...
37 S	14 E	...	10,000,000	...	...
38 S	2 W	10,000,000	...	...	...
38 S	1 W	...	...	...	...
38 S	1 E	1,600,000	...	...	...
38 S	2 E	33,000,000	3,000,000	1,000,000	...
38 S	3 E	92,000,000	4,880,000	...	2,000,000
38 S	4 E	145,000,000	20,000,000	25,000,000	...
38 S	5 E	90,000,000	4,000,000	13,000,000	300,000
38 S	6 E	103,000,000	6,000,000	15,000,000	...
38 S	7 E	57,000,000	15,700,000	...	...
38 S	8 E	3,500,000	3,960,000	...	...
38 S	9 E	...	...	...	...
38 S	10 E	...	...	...	...

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Alpine hemlock.	Western hemlock.	Engelmann spruce.	Total.
		Feet B. M.	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
36 S	6 E				175, 400, 000
36 S	7a E				3, 000, 000
36 S	7b E				21, 640, 000
36 S	8 E				84, 280, 000
36 S	9 E				136, 000, 000
36 S	10 E				40, 500, 000
36 S	11 E				66, 500, 000
36 S	12 E				2, 800, 000
36 S	13 E				113, 000, 000
37 S	14 E				8, 000, 000
37 S	2 W				1, 200, 000
37 S	1 W				30, 400, 000
37 S	1 E				32, 000, 000
37 S	2 E				100, 700, 000
37 S	3 E				193, 600, 000
37 S	4 E			3, 500, 000	276, 940, 000
37 S	5 E	3, 000, 000	2, 500, 000	400, 000	185, 900, 000
37 S	6 E	15, 000, 000		6, 000, 000	110, 800, 000
37 S	7 E				169, 800, 000
37 S	8 E				1, 400, 000
37 S	9 E				40, 320, 000
37 S	10 E				43, 100, 000
37 S	11½ E				18, 500, 000
37 S	11 E				57, 600, 000
37 S	12 E				100, 000, 000
37 S	13 E				95, 000, 000
37 S	14 E				52, 000, 000
38 S	2 W				30, 000, 000
38 S	1 W				
38 S	1 E				23, 600, 000
38 S	2 E				48, 000, 000
38 S	3 E				156, 880, 000
38 S	4 E				247, 900, 000
38 S	5 E		500, 000		156, 000, 000
38 S	6 E	2, 000, 000		3, 000, 000	218, 000, 000
38 S	7 E				190, 700, 000
38 S	8 E				21, 760, 000
38 S	9 E				11, 520, 000
38 S	10 E				22, 000, 000

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Nonforested.	Forested.	Yellow pine.	Sugar pine.	White pine.
		Acres.	*Acres.*	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
38 S	11½ E	21,400	1,640	2,240,000		
38 S	11 E	9,000	14,040	53,000,000		
38 S	12 E	5,800	17,240	84,000,000		
38 S	13 E	9,900	13,140	38,000,000		
38 S	14 E	14,000	9,040	8,000,000		
39 S	2 W	14,000	9,040	29,000,000		
39 S	1 W	5,800	17,240	73,000,000	9,000,000	
39 S	1 E	15,000	8,040	22,000,000	7,000,000	
39 S	2 E	12,500	10,540	7.000,000		
39 S	3 E	3,900	19,140	65,000,000	10,000,000	
39 S	4 E	5,000	18,040	122,000,000	31,000,000	
39 S	5 E	1,900	21,140	188,000,000	28,000,000	
39 S	6 E	4,200	18,840	60,000,000	15,000,000	
39 S	7 E	5,000	18,040	70,000,000	3,000,000	
39 S	8 E	14,720	8,320	10,880,000		
39 S	9 E	23,040				
39 S	10 E	18,500	4,540	10,000.000		
39 S	11½ E	15,360	7,680	22,500,000		
39 S	11 E	7,600	15,440	85,000,000		
39 S	12 E	15,400	7,640	42,000,000		
39 S	13 E	18,600	4,440	22,000,000		
39 S	14 E	15,000	8,040	8,000,000		
40 S	2 W	3,800	19,240	60,000,000	5,000,000	
40 S	1 W	6,000	17,040	26,000,000	8,000,000	1,000,000
40 S	1 E	4,500	18,540	36,000,000	16,000,000	
40 S	2 E	9,500	13,540	15,000,000	2,000,000	
40 S	3 E	11,000	12,040	16,000,000	2,000,000	
40 S	4 E	3,300	19,740	132,000,000	35,000,000	
40 S	5 E	2,600	20,440	170,000,000	60,000,000	
40 S	6 E	1,800	21,240	190,000,000	45,000,000	
40 S	7 E	1,300	21,740	175,000,000	8,000,000	
40 S	8 E	16,900	6,140	40,000,000		
40 S	9 E	23,040				
40 S	10 E	16,000	7,040	42,000,000		
40 S	11 E	18,000	5,040	5,000,000		
40 S	12 E	12,000	11,040	50,000,000		
40 S	13 E	12,800	10,240	50,000,000		
40 S	14 E	19,800	3,240	15,000,000		
40 S	14½ E	10,000	13,040	45,000,000		

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Red fir.	White fir.	Noble fir.	Incense cedar.
		Feet B. M.	*Feet B. M.*	*Feet B. M.*	*Feet B. M*
38 S.	11½ E.				
38 S.	11 E.	5,000,000	4,000,000		
38 S.	12 E.		2,000,000		500,000
38 S.	13 E.		4,000,000		2,000,000
38 S.	14 E.				
39 S.	2 W.	6,000,000			
39 S.	1 W.	21,000,000			
39 S.	1 E.	6,000,000			
39 S.	2 E.	3,000,000			
39 S.	3 E.	55,000,000	6,300,000		
39 S.	4 E.	80,000,000	4,000,000		2,850,000
39 S.	5 E.	95,000,000	10,000,000	4,000,000	3,000,000
39 S.	6 E.	105,000,000	15,000,000		800,000
39 S.	7 E.	15,000,000	7,000,000		900,000
39 S.	8 E.				
39 S.	9 E.				
39 S.	10 E.				
39 S.	11½ E.				
39 S.	11 E.		5,000,000		
39 S.	12 E.		4,000,000		
39 S.	13 E.				
39 S.	14 E.				
40 S.	2 W.	45,000,000		7,000,000	2,000,000
40 S.	1 W.	55,000,000	3,000,000	14,000,000	3,000,000
40 S.	1 E.	50,000,000	8,000,000	50,000,000	4,000,000
40 S.	2 E.	45,000,000	2,000,000	4,000,000	
40 S.	3 E.	51,200,000			400,000
40 S.	4 E.	70,000,000	10,000,000		1,000,000
40 S.	5 E.	100,000,000	17,000,000		3,620,000
40 S.	6 E.	75,000,000	9,000,000		1,000,000
40 S.	7 E.	65,000,000			
40 S.	8 E.	9,000,000	3,980,000		
40 S.	9 E.				
40 S.	10 E.				
40 S.	11 E.				
40 S.	12 E.				
40 S.	13 E.	5,000,000	6,000,000		1,000,000
40 S.	14 E.				
40 S.	14½ E.				

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Alpine hemlock.	Western hemlock.	Engelmann spruce.	Total.
		Feet B. M.	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
38 S	11½ E				2,240,000
38 S	11 E				62,000,000
38 S	12 E				86,500,000
38 S	13 E				44,000,000
38 S	14 E				8,000,000
39 S	2 W				35,000,000
39 S	1 W				103,000,000
39 S	1 E				35,000,000
39 S	2 E				10,000,000
39 S	3 E				136,300,000
39 S	4 E				239,850,000
39 S	5 E				328,000,000
39 S	6 E				195,800,000
39 S	7 E				95,900,000
39 S	8 E				10,880,000
39 S	9 E				
39 S	10 E				10,000,000
39 S	11½ E				22,500,000
39 S	11 E				90,000,000
39 S	12 E				46,000,000
39 S	13 E				22,000,000
39 S	14 E				8,000,000
40 S	2 W				119,000,000
40 S	1 W				110,000,000
40 S	1 E				164,000,000
40 S	2 E				68,000,000
40 S	3 E				69,600,000
40 S	4 E				248,000,000
40 S	5 E				350,620,000
40 S	6 E				320,000,000
40 S	7 E				248,000,000
40 S	8 E				52,980,000
40 S	9 E				
40 S	10 E				42,000,000
40 S	11 E				5,000,000
40 S	12 E				50,000,000
40 S	13 E				62,000,000
40 S	14 E				15,000,000
40 S	14½ E				45,000,000

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Nonforested.	Forested.	Yellow pine.	Sugar pine.	White pine.
		Acres.	*Acres.*	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
41 S....	2 W..	3,000	7,200	16,000,000	5,000,000	3,000,000
41 S....	1 W..	1,200	9,000	60,000,000	12,000,000	....
41 S....	1 E...	300	9,900	40,000,000	15,000,000	....
41 S....	2 E...	2,000	8,200	3,000,000	2,000,000	....
41 S....	3 E...	3,200	7,000	6,000,000	....	....
41 S....	4 E...	2,400	7,800	42,000,000	4,800,000	....
41 S....	5 E...	....	10,200	50,000,000	15,000,000	....
41 S....	6 E...	1,200	9,000	58,000,000	....	....
41 S....	7 E...	1,000	9,200	78,000,000	....	....
41 S....	8 E...	8,320	2,800	12,000,000	....	....
41 S....	9 E...	11,520	....	....	....	....
41 S....	10 E...	11,520	....	....	....	....
41 S....	11 E...	10,720	800	4,500,000	....	....
41 S....	12 E...	11,520	....	....	....	....
41 S....	13 E...	3,000	8,520	34,000,000	....	....
41 S....	14 E...	....	11,520	55,000,000	....	....
41 S....	14½ E..	8,020	3,500	3,000,000	....	....

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Red fir.	White fir.	Noble fir.	Incense cedar.
		Feet B. M.	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
41 S....	2 W..	22,000,000	1,600,000	40,000,000	1,500,000
41 S....	1 W..	28,000,000	3,000,000	5,000,000	1,700,000
41 S....	1 E...	4,240,000	10,000,000	....	8,000,000
41 S....	2 E...	4,600,000	1,000,000	....	....
41 S....	3 E...	4,000,000	....	....	....
41 S....	4 E...	17,800,000	400,000	....	2,000,000
41 S....	5 E...	30,000,000	4,000,000	....	1,000,000
41 S....	6 E...	29,500,000	....	....	....
41 S....	7 E...	17,000,000	....	....	....
41 S....	8 E...	2,000,000	....	....	....
41 S....	9 E...	....	....	....	....
41 S....	10 E...	....	....	....	....
41 S....	11 E...	....	....	....	....
41 S....	12 E...	....	....	....	....
41 S....	13 E...	7,000,000	3,000,000	....	1,000,000
41 S....	14 E...	....	....	....	....
41 S....	14½ E..	....	....	....	....

Areal and timber estimates, by townships, of region examined—Continued.

T.	R.	Alpine hemlock.	Western hemlock.	Engelmann spruce.	Total.
		Feet B. M.	*Feet B. M.*	*Feet B. M.*	*Feet B. M.*
41 S....	2 W..	....	....	....	89, 100, 000
41 S....	1 W..	....	....	....	109, 700, 000
41 S....	1 E...	....	....	....	77, 240, 000
41 S....	2 E...	....	....	....	10, 600, 000
41 S....	3 E...	....	....	....	10, 000, 000
41 S....	4 E...	....	....	....	67, 000, 000
41 S....	5 E...	....	....	....	100, 000, 000
41 S....	6 E...	....	....	....	87, 500, 000
41 S....	7 E...	....	....	....	95, 000, 000
41 S....	8 E...	....	....	....	14, 000, 000
41 S....	9 E...	....	....	....	....
41 S....	10 E...	....	....	....	....
41 S....	11 E...	....	....	....	4, 500, 000
41 S....	12 E...	....	....	....	....
41 S....	13 E...	....	....	....	45, 000, 000
41 S....	14 E...	....	....	....	55, 000, 000
41 S....	14½ E..	....	....	....	3, 000, 000

RECAPITULATION.

Total stand of timber.

Species.	Michigan practice.	Local practice.	Difference.
	Feet B. M.	*Feet B. M.*	*Feet B. M.*
Yellow pine	9, 477, 520, 400	6, 973, 740, 000	2, 503, 780, 400
Sugar pine	813, 902, 100	712, 400, 000	101, 502, 100
White pine	130, 470, 500	88, 300, 000	42, 170, 500
Red fir	6, 638, 264, 800	4, 358, 500, 000	2, 279, 764, 800
White fir	1, 215, 526, 000	242, 500, 000	973, 026, 000
Noble fir	885, 824, 400	528, 000, 000	357, 824, 400
Incense cedar	91, 393, 600	44, 600, 000	46, 793, 600
Alpine hemlock	609, 619, 800	308, 800, 000	300, 819, 800
Western hemlock	46, 718, 200	8, 500, 000	38, 218, 200
Engelmann spruce ...	71, 969, 400	37, 000, 000	34, 969, 400
Total	19, 981, 209, 200	13, 302, 340, 000	6, 678, 869, 200

This makes a difference of 33.4 per cent between the two estimates on the amount of timber under the Michigan practice.

There is another "practice" which could be used in estimating the timber in this region. That is the cutting practice of the Pokegama Lumber Company, the largest concern operating in the region. This "practice" aims to make so thorough a clean up that there shall never be occasion again to log on the tracts they have passed over, at least so far as regards the pine component of the forest. Applying their method to the forest everywhere in the region covered by this statement and including all species of trees fit to manufacture into lumber, I estimate as indicated in the table below, the estimates as reached by Michigan practice being multiplied by the factors given:

	Factor.
Yellow pine	1.35
Sugar pine	1.02
White pine	1.03
Red fir	2.
White fir	3.70
Noble fir	1.04
Incense cedar	1.001
Alpine hemlock	1.002
Western hemlock	1.001
Engelmann spruce	1.1

Applying these factors to our Michigan practice estimates we obtain results as follows:

	Feet B. M.
Yellow pine	12,794,652,540
Sugar pine	830,180,142
White pine	134,384,615
Red fir	13,276,529,600
White fir	4,497,446,200
Noble fir	921,257,376
Incense cedar	91,484,993
Alpine hemlock	610,839,039
Western hemlock	46,764,918
Engelmann spruce	79,166,340
Total	33,282,705,763

These totals would then represent the ultimate quantity of mill timber the region would yield if logged to its utmost capacity. But no one here estimates timber that way, nor do the sawmills ever cut so close unless there be exceptional circumstances making such a practice compulsory. The estimates here named "Michigan practice" are on the basis of a fair, judicious use of the forest.

No attempt has been made to estimate the forest in cubic feet. All such estimates would be the merest guesswork. In a calculation of that sort would naturally enter the immense quantities of small growth lodgepole pine and alpine hemlock that occur on the summit and on the eastern slopes of the Cascades. To estimate the cubic contents of the forest in the region covered by me during the past summer would require at least ten years, provided a reasonable degree of accuracy was demanded.

The factors employed in estimating per "cutting practice" depend chiefly upon the relative proportion that the crown of the tree bears to the trunk; that is to say, upon that portion of the crown which is not too branchy or knotty when trimmed up to be absolutely unavailable for mill use. There is in this respect a good deal of difference between the timber on the west and east sides of the Cascades. The western side grows much longer timber, all through, than does the eastern. The factors are compiled to represent a general average.

STANISLAUS AND LAKE TAHOE FOREST RESERVES, CALIFORNIA, AND ADJACENT TERRITORY

BY

GEORGE B. SUDWORTH

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STANISLAUS AND LAKE TAHOE FOREST RESERVES, CALIFORNIA, AND ADJACENT TERRITORY.

By George B. Sudworth.

INTRODUCTION.

The information presented in this report is based on a personal reconnaissance of the territory, made during the summer of 1899. The half-tone illustrations are from photographs taken at the same time.

The lack of railroad facilities and the insufficient number of stage lines made it necessary to perform the necessary travel on horseback, with an attending pack outfit.

Much of the territory examined has, from the value of its mineral and other resources, been long traversed by miners and other transient settlers. As a result the region is penetrated and crossed in certain portions by a number of rough wagon roads (see Pl. XCI, *B*) and innumerable intricate trails. Unfortunately, however, several important wagon roads and trails used by early emigrants have been abandoned and are now so thickly overgrown by forest trees as to be impassable. This fact and the roughness of the country made it difficult to penetrate some parts of the territory studied.

The western part of the territory is directly accessible by roads and trails and the country is of such a nature as to allow direct routes, while much of the eastern part can not be reached except by long detours. This is due to the existence of deep, impassable canyons.

The territory was traversed by crossing and recrossing from east to west at sufficient intervals to afford an accurate idea of the composition of the forests and also of the areal and altitudinal distribution of the timber species. In order to make the examination still more comprehensive, many side trips were made into territory lying between the regular routes of travel. General features and the relationships of different forest types were studied from numerous elevations throughout the region. The composition of the various types of forest and the relative abundance of timber and other tree species was determined by careful study and measurements of sample wooded areas.

These sample areas were so selected from various parts of commercial forests that it is believed an adequate idea of composition and stand was thus obtained for the entire region examined.

About 500 photographs were taken as an integral part of field notes, and also with a view to securing a systematic photographic description of all the forest and related features of the region. A part of these pictures are reproduced for illustration in the present report.

BOUNDARIES.

LAKE TAHOE FOREST RESERVE.

The boundaries of this reserve are as follows:

Townships eleven (11), twelve (12), and thirteen (13) north, range sixteen (16) east, Mount Diablo base and meridian, California; townships eleven (11), twelve (12), and thirteen (13) north, range seventeen (17) east, and so much of township eleven (11) north, range eighteen (18) east, as lies west of the summit of the Sierra Nevada Range of mountains in El Dorado County, California.

The area is 213 square miles, or 136,335 acres.

STANISLAUS FOREST RESERVE.

Beginning at the southeast corner of township three (3) north, range twenty-four (24) east, Mount Diablo base and meridian, California; thence northerly along the range line to the northeast corner of said township; thence westerly along the township line to the northwest corner of said township; thence northerly along the range line to the township line between townships four (4) and five (5) north, range twenty-three (23) east; thence easterly along the township line to the southeast corner of township five (5) north, range twenty-three (23) east; thence northerly along the range line to the northeast corner of said township; thence westerly along the first (1st) standard parallel north to the southwest corner of township six (6) north, range twenty-two (22) east; thence northerly along the range line between ranges twenty-one (21) and twenty-two (22) east to the northeast corner of township seven (7) north, range twenty-one (21) east; thence westerly along the township line to the northwest corner of said township; thence northerly along the range line to the northeast corner of township eight (8) north, range twenty (20) east; thence westerly along the surveyed and unsurveyed township line between townships eight (8) and nine (9) north to the northwest corner of township eight (8) north, range seventeen (17) east; thence southerly along the range line to the southeast corner of township eight (8) north, range sixteen (16) east; thence easterly along the unsurveyed township line to the point for the southeast corner of township eight (8) north, range seventeen (17) east; thence southerly along the unsurveyed and surveyed range line between ranges seventeen (17) and eighteen (18) east, subject to the easterly offset on the first (1st) standard parallel north, to the southeast corner of township four (4) north, range seventeen (17) east; thence easterly along the township line to the northeast corner of township three (3) north, range eighteen (18) east; thence southerly along the range line to the southeast corner of said township; thence easterly along the township line between townships two (2) and three (3) north to the southeast corner of township three (3) north, range twenty-four (24) east, the place of beginning.

The area is 1,080 square miles, or 691,200 acres.

A. CALIFORNIA WHITE OAK (QUERCUS DOUGLASII HOOK AND ARN.), SOUTHERN CALAVERAS COUNTY.

B. TYPICAL WAGON ROAD IN YELLOW-PINE FOREST, SOUTHWESTERN SECTION OF STANISLAUS FOREST RESERVE.

A. LONG BARN, A TYPICAL ROAD STATION IN YELLOW-PINE BELT, NORTH FORK OF TUOLUMNE RIVER.

B INTERIOR OF YELLOW-PINE FOREST ON NORTH FORK OF TUOLUMNE RIVER.

TERRITORY EXAMINED.

The territory examined is comprised in the six following atlas sheets of the United States Geological Survey: Big Trees, Pyramid Peak, Placerville, Jackson, Dardanelles, and Markleeville. Practically all of the Lake Tahoe and Stanislaus forest reserves are included in these quadrangles.

Roughly estimated, the area of the territory examined amounts to 5,116 square miles, or about 3,270,000 acres.

GENERAL TOPOGRAPHIC FEATURES.

This region is representative of the general character of the Sierra Nevada, the high crests of which are reached by a long rise from the broad San Joaquin River Valley. The western border of the region has an altitude of about 500 feet, which increases to 10,000 feet and over as the summit is reached. This general slope is made up of rolling, wide valleys and low, soil-covered foothills on the west, while going eastward the valleys grow smaller and the foothills are replaced by high, rocky mountain ranges and peaks. Scattered among these high ranges are a few large subalpine lakes, the principal of which are Lake Tahoe and Fallen Leaf Lake. Cascade, Echo, Blue, Silver, and Loon lakes are important, but much smaller. Most of these lakes are situated in the north-central part of the region examined. Smaller lakes, ponds, and marshes are more or less common among the high mountains (Pls. CV, *B*, and CVIII, *A*).

The salient features in the eastern or more mountainous part of the territory are the high peaks known as the Dardanelles, Pyramid Peak, Mokelumne Peak, Round Top, Elephants Back, Jacks Peak, Dicks Peak, Mount Tallac, and Rubicon Peak. These peaks rise from high, rocky ranges, and have altitudes ranging from 9,000 to 10,400 feet. There are also numerous lesser peaks, ranging from 8,000 to 9,000 feet in elevation. The common elevation of the mountain valleys and canyon bottoms in the region of these peaks is from 5,000 to 7,000 feet.

Equally striking features in the general topography of the region are the deep river canyons which traverse the country more or less from northeast to southwest. Five important rivers and their numerous tributaries drain the region. The Rubicon River and the North and Middle forks of American River drain the northwestern and northern border of the region, while the South Fork of American River crosses the entire northern part, the headwaters of this stream lying south of Lake Tahoe. The North, Middle, and South forks of Cosumnes River lie mainly in the west-middle portion of this territory, while a few head branches extend eastward about halfway across the region. The upper main Mokelumne River and its North Fork cut the south half of this region from east to west, and this, with

American River, is the only stream which completely crosses the strip of country studied.

Calaveras River drains only the southwestern part, while the North, Middle, and South forks of Stanislaus River drain the south-central and southeastern portion of the region.

These streams and their larger tributaries are similar in general character. Except for parts of the streams within the west border of the region, the beds of these rivers are rough with huge bowlders and lie in deep gorges, canyons, or narrow valleys (see Pls. XCVII, *A*, and CVII, *A* and *B*). At high water the principal rivers in the middle and eastern sections vary from 10 to 20 yards in width, and the main channels of these streams in the western sections are from 25 to 50 yards in width. The depth of water carried during the dry months—August, September, and October—ranges from 3 or 4 inches to 1 or 2 feet, while several of even the larger streams contained no water at all, or only a few pools (see Pls. CVII, *A* and *B*, and CXII *A*). Low water is most common in the western sections of the region. This scarcity of water, or entire lack of it, is, however, partly explained by the fact that numerous large ditches, supplying mining camps and other settlements, take large quantities of water from near the headwaters of all these streams.

As a rule, the flow of streams in the high mountain region is very rapid, while in the western sections the fall in the streams is much less, and the water flows slowly (see Pl. CXII, *A*).

The sides of the canyons are usually rocky and steep, especially in the eastern sections, while in some localities they are precipitous or almost perpendicular walls of granite rock (see Pls. XCVII, *A*, CVII, *B*, CVIII, *B*, and CXIV, *B*).

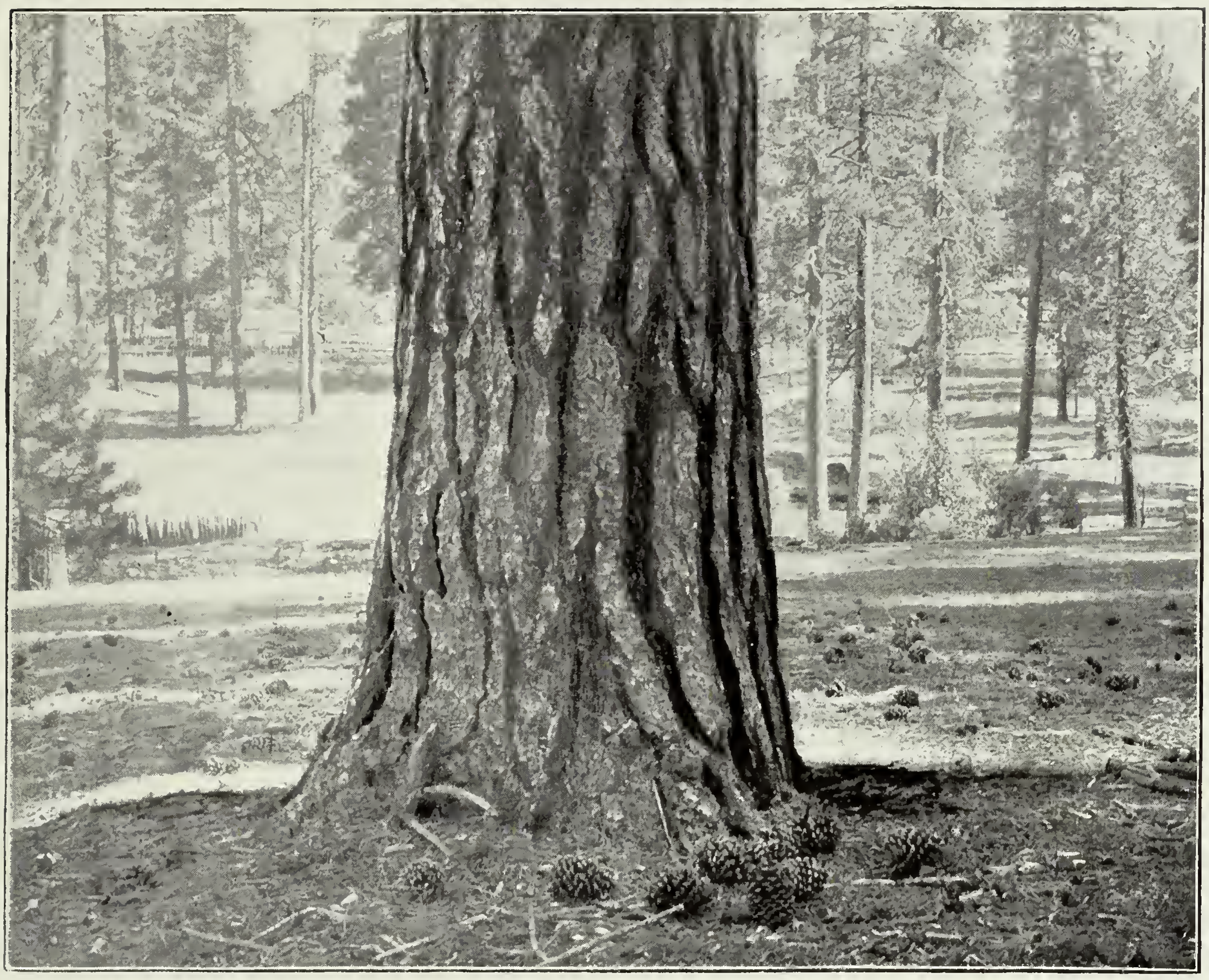
Where soil is present it is for the most part a light-brown clayey loam. A very striking feature, however, of the eastern and northern sections is that the surface of the mountains is bare granite rock, supporting the tree and other growths in pockets and crevices of the rock, or on small soil-covered rocky benches (see Pls. XCVI, *B*, and CVIII, *B*).

WATER SUPPLY.

Only a general impression could be gained as to the supply and consumption of water in this region. But it may be safely stated that the natural supply of water for all purposes is generally adequate during the dry months. A few localities were found where the local wells, springs, and streams were dry, forcing the settlers to haul water from distant sources.

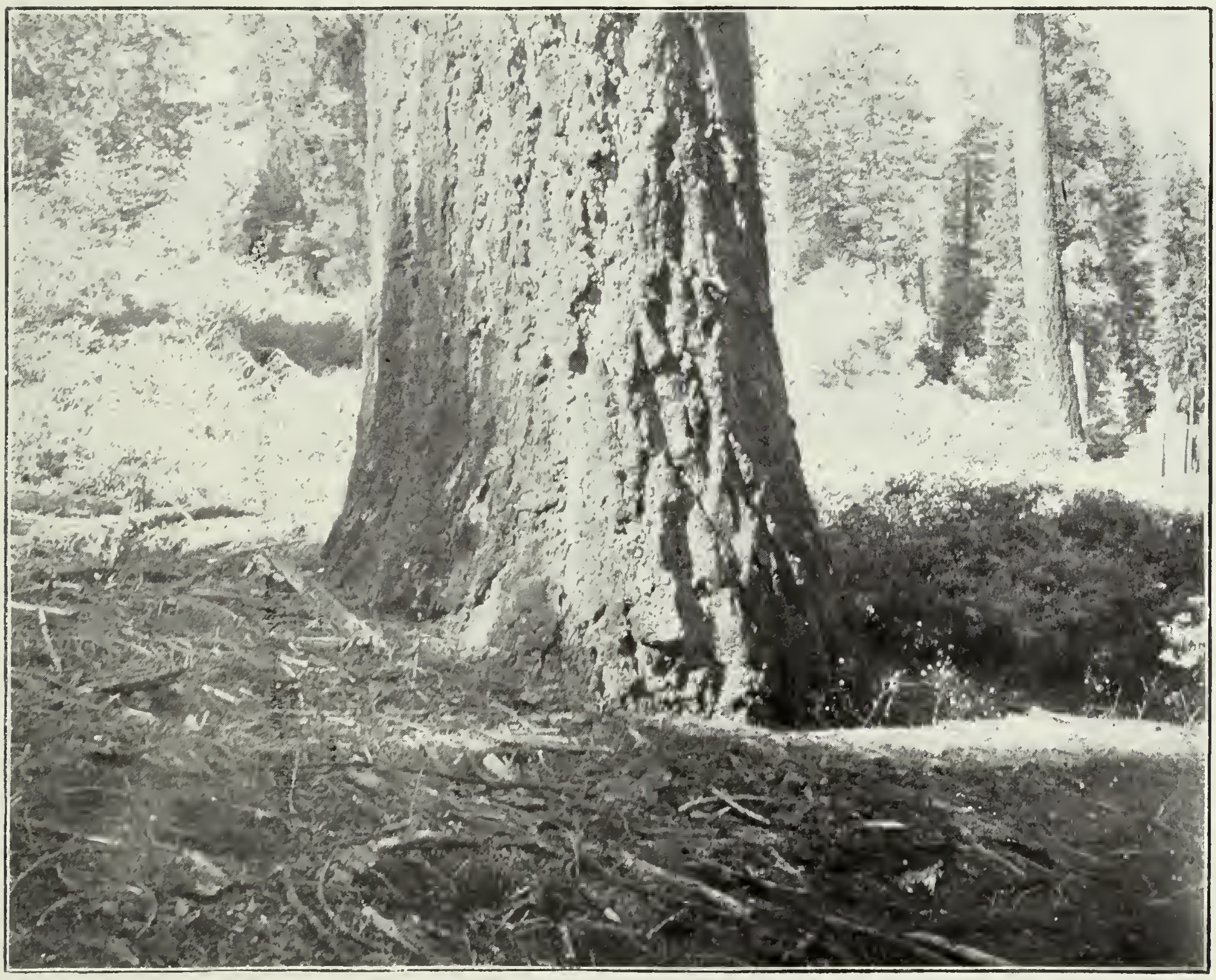
SETTLEMENTS.

Although the territory has been thoroughly explored and long traversed by miners, lumbermen, shake makers, and by sheep herders



A. JEFFREY PINE (PINUS JEFFREYI "OREG. COM.") 4 FEET IN DIAMETER.

This shows best form of timber trees in yellow-pine belt, headwaters of South Fork of Stanislaus River, Stanislaus Forest Reserve.



B. WHITE FIR (ABIES CONCOLOR PARRY) 4½ FEET IN DIAMETER.

Headwaters of South Fork of Stanislaus River, Stanislaus Forest Reserve.

and cattlemen, there is little permanent settlement except in the southwestern and western sections. The principal towns in these sections are Confidence, Columbia, Robinsons Ferry, Vallecito, Murphy, Sheep Ranch, Mountain Ranch, Lotus, Coloma, Georgetown, Amador, Sutter Creek, Angels, San Andreas, Mokelumne Hill, Jackson, and Placerville, the last eight being the largest and most important. Nearly all are situated at elevations between 1,000 and 2,000 feet. The location and permanency of these settlements is determined by the presence and continuance of mining interests. With few exceptions, the agricultural and horticultural interests of these localities are merely incidental.

Throughout the more mountainous territory there are numerous unimportant points called settlements, which are chiefly temporary lumber "camps," provision stores, toll houses, taverns, and feed stations, or isolated cabins occupied by transient settlers during the summer months only. Temporary post-offices are located at a few of these mountain points, and are reached by rough wagon roads. Summer resorts are maintained at several points on Lake Tahoe for the benefit of tourists. The resorts within the territory examined are Tallac post-office at the southwest extremity of the lake, and two others—Murphy and Tahoe post-offices—on the west side of Lake Tahoe. Communication with these points and railroad connection at the north end of the lake is maintained by small steamers. Land communication with these resorts is only by rough trails.

As already stated, the mountain settlements, or most of those at elevations above 3,000 feet, are temporary, being occupied during the summer only. This is due to the heavy winter snows, which prevent communication with the lower permanent villages from which the mountain settlements derive nearly all provisions and other supplies. Very few people remain in this snowy region during the winter, the majority leaving by the middle or last of October.

INDUSTRIES.

The principal industries of this territory are, in order of their importance, gold and copper mining, grazing, agriculture and fruit growing, and lumbering and allied timber industries.

MINING.

Mining is carried on chiefly in the southern and western sections, and is concerned mostly with the production of gold. Only three important copper mines were found. These were near Campo Seco and Copperopolis. The largest mining operations are confined to the vicinity of the various towns mentioned as permanent settlements, while a large number of small operations are carried on more or less distant from these places (see Pl. CX, *A*).

At present deep-shaft mining is resorted to almost entirely, and as this requires the use of expensive machinery, it is possible for only large capital to carry on such operations (see Pl. CXIV, *A*). Placer mining and shallow pocket mining in quartz are carried on in many localities by individuals whose equipment consists of a shovel, pick and sluice or hand drill, and a few sticks of dynamite. With few exceptions, the returns from these forms of mining appear to be small. The thrifty Chinaman, who is satisfied with the small but sure daily income from washing the gravel and silt of river beds, is the only one of these poorer miners who is improving his condition.

The highly profitable placers of the early fifties and sixties appear to be generally exhausted. In all the foothill sections everywhere there is evidence of former extensive mining of this kind, where now there are standing forests of 50-year-old trees. Towns at one time of some importance have disappeared, and their sites are now marked only by heaps of gravel, the ruins of log cabins, and crumbling stone chimneys.

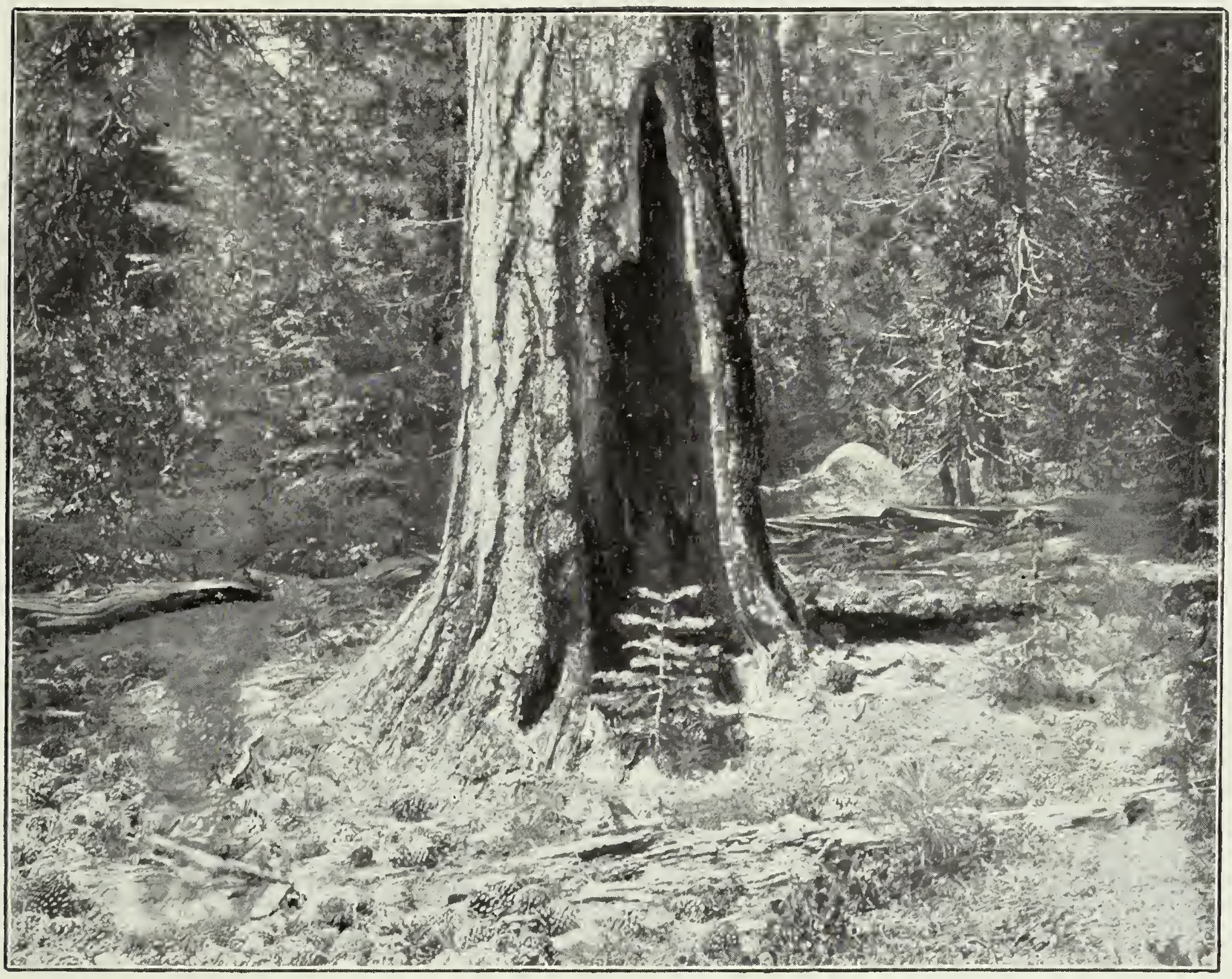
The larger mining operations of the present time give the principal life to the small towns. They are important to the region also, as they afford a market for the lumber derived from the higher wooded country and for agricultural and other products from the lower hill and plains districts. Owing, however, to the lack of railroad facilities, all commodities are freighted long distances by teams and are high priced in proportion to the distance hauled.

GRAZING.

Grazing is an important industry throughout this region in connection with the production of beef, mutton, wool, and butter. The grazing of cattle for beef and the grazing of stock cattle for dairy products are separate industries, and there is also the grazing of sheep and goats. The grazing of beef cattle and sheep is the largest of these industries. With some exceptions sheepmen are not landowners, but depend for forage on transiently hired pasturage or, to a greater extent, on the public domain. Cattle raisers are more often owners of ranches in the foothills or valleys, where for a portion of the year their stock is cared for.

The low valleys and foothill country of the southern and western sections afford grazing for both stock and beef cattle, and also for sheep during the fall, winter, and spring. About July, however, cattle and sheep are driven for the summer to ranges in the high mountain regions, from which they are withdrawn by the middle or last part of October. No animals are intentionally left in the mountains during winter on account of the deep snow.

Most of the cattlemen claim to own large tracts of the mountain land, a portion of which is fenced, but the larger part of the range used by



A. YELLOW PINE (PINUS PONDEROSA LAWS.) 3 FEET IN DIAMETER.

Near Middle Fork of Stanislaus River, west section of Stanislaus Forest Reserve.

B. CHARACTERISTIC DISTRIBUTION OF YELLOW PINE IN FORESTS.

East slope of Middle Fork of Stanislaus River, between Cow Creek and Lily Creek, Stanislaus Forest Reserve.

beef cattle is unfenced forest land. Simple cabins are maintained on the fenced parts of the range and are the headquarters of the riders who, in this exceedingly rough and broken country, are obliged to follow the drifting of cattle during the entire summer (see Pl. XCV, *A*). If a careful watch is not kept on the general movement of the cattle, many animals are likely to be missed in the fall round-up. Dairy ranchmen graze their herds entirely within fenced ranges in the higher mountains, always including as much alpine meadow land as possible. The extreme precautions taken by dairymen not to lose animals from their herds, even on a fenced range, is illustrated by the fact that every animal wears a bell. The din raised by 300 or 400 of these cattle close to camp at night is not conducive to slumber.

The necessity for constantly seeking new pasture makes it impossible for sheepmen to maintain headquarters at one point in the mountain range longer than a week or two at most, but they graze their flocks over areas within boundaries fixed by common consent, or by priority of possession from year to year. The ranges used by sheepmen are usually those not claimed or used by cattlemen, for, although sheep will graze after cattle, the latter will not graze after sheep. On account of this, and also because forage is exceedingly short on all the unfenced mountain ranges, very bitter feeling exists between cattlemen and sheepmen. The latter are constantly encroaching not only on unfenced but also on fenced cattle ranges. When discovered these encroachments are resented, and sometimes result in the destruction of large numbers of sheep and not infrequently in the loss of human life on both sides.

AGRICULTURE AND AGRICULTURAL LANDS.

Agriculture, including also fruit growing, is a relatively small industry in this region for the reason that only a small percentage of the total area is available for this purpose. As shown by the accompanying maps (Pls. LXXXV–XC), the most extensive tracts of agricultural lands lie near the western and southwestern borders, at elevations of from 500 to 1,500 feet. Small isolated bodies of arable land are found in the narrow valleys of the foothills, while still smaller parcels are found throughout the western half of this region at elevations ranging from 2,000 to 3,000 feet. Most of these small tracts are near mining towns, which afford markets for the fruit and hay produced. Unlike the ranchmen of lower elevations, who depend entirely on agriculture or fruit growing, or both combined, many of the ranchmen of the foothills and mountain valleys derive only a part of their support from tillage. They resort also to hauling lumber, mining-timber, wood, ore, hay, etc.

Wheat hay and barley hay are the principal forage crops raised. Alfalfa and timothy are raised for hay in the lower broad river valleys, and also in the Carson Valley country, but with these exceptions the hay of this region consists mainly of wheat and barley cut and cured when from one-half to two-thirds ripe. A wild oat (*Avena*), which grows very abundantly without cultivation on all the foothills, is extensively cut for hay, but is a poor substitute for the more nutritious wheat and barley. Comparatively little wheat and barley are cut for grain, except in the larger border agricultural districts. The bulk of the grain comes from grain-producing centers west and southwest of this region.

The highest altitude at which wheat and barley were seen growing in the mountain valleys was 5,000 feet, which is exceptionally high, as, for the most part, these grains are not grown above 3,000 feet.

Practically none of these agricultural lands are irrigated, the main grain and hay crops depending entirely on the fall and spring rains. The lack of irrigation water makes it impossible to raise alfalfa and other perennial forage crops, as they can not survive the long drought which succeeds the spring rains. Crops of this kind were seen only in the lower moist river bottoms near the southwestern border of this region.

Fruit growing is not a large industry, and, like the more extensive agricultural operations, is carried on chiefly in the southwestern and western border valley and hill country below 1,000 feet elevation. Small fruit ranches are occasionally found in the vicinity of settlements as high as 3,500 feet, but usually not above 1,500 feet.

The fruits raised are mostly wine grapes, peaches, apricots, almonds, pears, and apples of small size and inferior quality. English walnuts are also raised to a limited extent, and near Coloma and Campo Seco a few hundred orange trees were seen in bearing.

The quantity of fruit produced is comparatively small, and in some localities is annually growing less and of poorer quality, while a great many vineyards have been abandoned. Total failures and small and decreasing production are said to be due, however, to the scanty rainfall of recent years and the general lack of irrigation water. Large almond orchards in the southwestern hill country failed to mature their heavy crops during 1899 on account of lack of rain.

LUMBERING.

Lumbering is carried on in the south-central and middle districts, and the output of all sawmills is consumed largely at the shaft mines and towns in the vicinity. The following nine sawmills are the principal and largest:

Bradford mill, on and near the headwaters of the North Fork of Tuolumne River; McKay mill, on the headwaters of Love Creek (tributary of North Fork of Stanislaus River); Monucle mill, near the mouth of Moran Creek (tributary of above river); Whitmore mill, on the head-

A. CATTLE HERDER'S SUMMER CABIN, BEAR MEADOWS, STANISLAUS FOREST RESERVE.

B. CALIFORNIA RED FIR (ABIES MAGNIFICA MURR.) 39 INCHES IN DIAMETER.

West slope of Middle Fork of Stanislaus River, near headwaters of Lily Creek, Stanislaus Forest Reserve.

waters of Mill Creek (tributary North Fork of Mokelumne River); Banner mill, on the headwaters of Jesus Maria Creek (tributary North Fork of Calaveras River), a few miles north of Mountain Ranch; Beech mill, near the head of Big Iowa Canyon (tributary to South Fork of American River), 18 miles northeast of Placerville; Blair's mill, in Sly Park, on the middle course of Sly Park Creek (tributary North Fork of Cosumnes River); Chicacola mill, near the headwaters of the South Fork of Cosumnes River; Twelvemile House mill, near the head of Deep Canyon (tributary of Pilot Creek, a south branch of the Middle Fork of American River).

The following five sawmills are the smallest and least important in the region:

Loon Lake Flume Company mill, 8 miles southwest of Loon Lake on a branch of Little Gerlé Creek; McCarty and Bruce mill, near West Point; Barclay mill, 2 miles north of Indian Diggins; Blue Lakes Water Company mill, near the head of Bear River; and a very small mill (owner unknown) 3 miles northeast of Pleasant Valley on Clear Creek.

A nearly equal number of abandoned sawmills were found throughout the regions in which the present active mills are located. Most of these old mills were abandoned for lack of saw timber. The work of these mills dates back from fifteen to twenty years.

The active mills have been in operation from one to ten years, and the daily capacity of the larger ones is comparatively greater than those of former times and is from 7,000 to 15,000 feet B. M., while the smaller mills cut from 2,000 to 6,000 feet per day. The period of activity is from April to November. A common practice of mill operators is to consume all saw timber in a radius from the plant of from 2½ to 3 miles, and then move to another site. Logs are hauled to the mills chiefly by two- and four-wheeled trucks (see Pl. CX, *B*), or occasionally by the combined use of horse tram cars and steel cables and donkey engines. The timber cut is mainly yellow pine. In some localities, however, 25 to 40 per cent of the cut consists of white fir, red fir, sugar pine and Jeffrey pine, the latter, however, passing for yellow pine. Incense cedar is sawed for telephone and telegraph poles. The lumber cut from the other kinds mentioned consists largely of inch boards, planking, and large square timber.

All the lumber manufactured is consumed within the region.

TIMBER INDUSTRIES ALLIED TO LUMBERING.

There are, in addition to sawmill operations, two other important timber-consuming industries. These are the cutting of round and rived mining timber and shakes. The round timber is extensively used for heavy props in all shaft mining, while the rived material, known as lagging, is used for minor stay work in these mines (see Pl.

CXIII, *B*). The riving of shakes, which are a common substitute for shingles, is an old and important industry. A very large number of ordinary dwellings and other buildings throughout the region are roofed and a great many sided also with this material. The newer buildings of the larger towns, especially those near railroad communications, are roofed with sawed shingles, but prior to the advent of railroads in the foothill region, shakes were the only roofing material used.

Round mining timber and lagging are derived entirely from yellow and Jeffrey pine, while shakes are made almost entirely from sugar pine, yellow pine and white fir being seldom used.

FOREST LAND.

Seventy-five or 80 per cent of this region is more or less wooded. In traversing this area from the lowest to the highest timber line there are three natural divisions which can be made in the forest land. These are: First, a narrow belt of thinly stocked woodland, occupying the foothills and ranging from an elevation of about 500 feet up to about 2,000 feet; second, a broader, more or less dense and important belt of timber forest, extending from about 2,000 feet elevation up to 6,000 feet; third, a belt of open, less important timber forest, ranging from about 6,000 feet elevation up to 8,500 and 9,500 feet. These higher elevations represent the variation of timber line. For convenience these divisions may be termed the lower, middle, and upper timber belts.

The lower or foothill belt merges on the west into rolling grass lands with only very scattered tree growth, forming where this practically disappears an irregular line running in a northwest-southeast direction. Tongues of the lower tree belt extend eastward into the middle belt, forming where they terminate an equally irregular line. The line of separation between the middle and upper timber belts is similarly intricate.

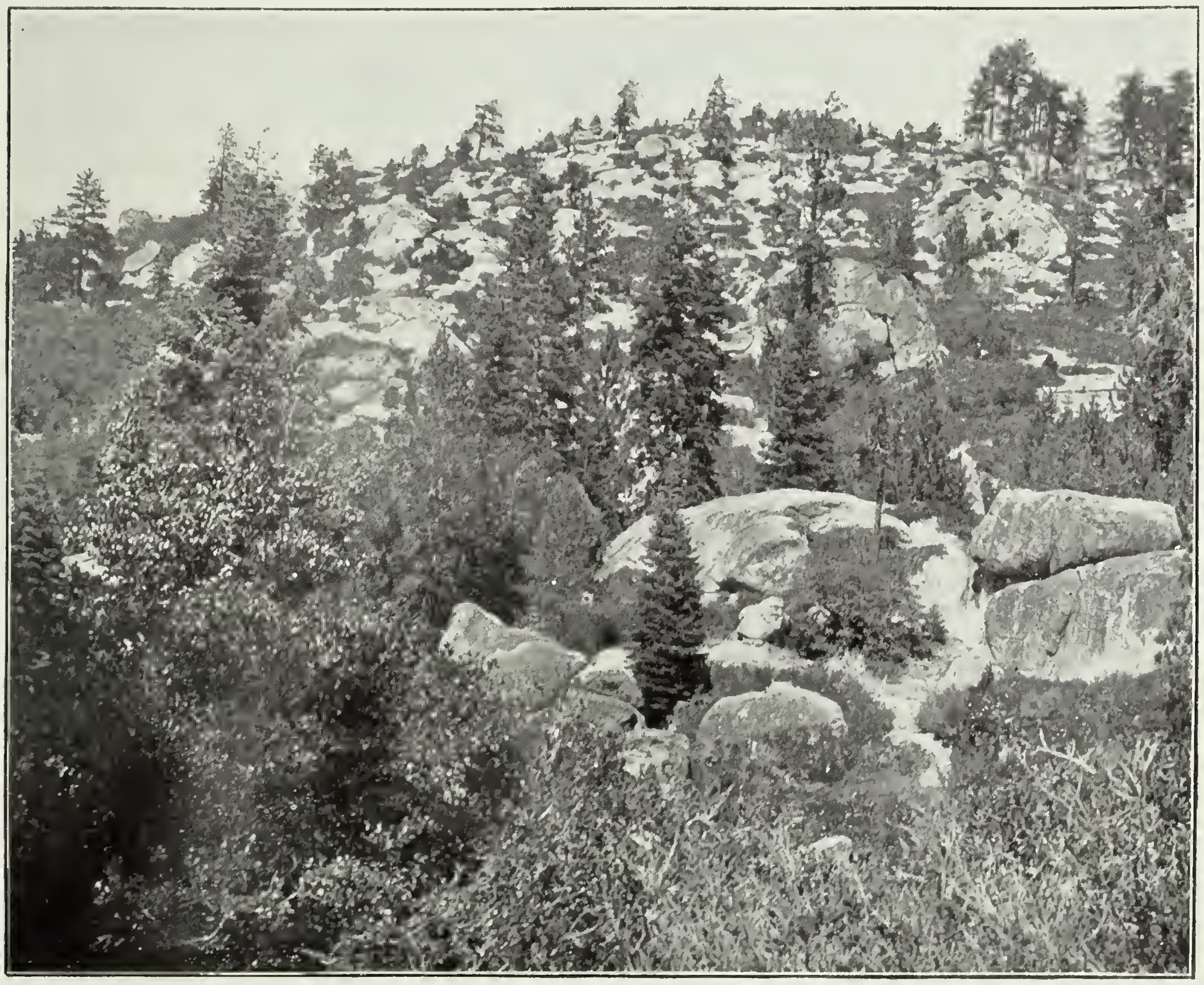
The basis of this separation into timber belts is the more or less regular occurrence of certain timber trees within successive intervals of altitude. The lines of separation are very irregular and not always sharply defined, for there is a greater or less overlapping where the species of adjoining belts come together. But the lines separating these belts are perfectly discernible where, for example, the species of the lower belt cease, and the species of the next higher belt appear.

GENERAL CHARACTER AND DISTRIBUTION OF FORESTS.

The general character of the three timber belts which make up the forests of this region is strikingly different. The lower belt is rightly termed woodland of little commercial value, while the middle belt is a

A. SUGAR PINE (PINUS LAMBERTIANA DOUGL.) 50 INCHES IN DIAMETER.

West slope of Middle Fork of Stanislaus River, near headwaters of Cow Creek, Stanislaus Forest Reserve.



B. CHARACTERISTIC SCATTERED AND STUNTED GROWTH OF CALIFORNIA RED FIR, JEFFREY PINE, AND JUNIPER.

High rocky summits on headwaters of Lily Creek, Stanislaus Forest Reserve.

true timber forest of the highest commercial value, both on account of the quality and quantity of its timber and also on account of accessibility. Covering large watersheds, it is also of great value as protective forest. The upper belt is in part a timber forest, but altogether of less commercial value than the middle section, because of inaccessibility and the poorer quality and smaller quantity of timber it contains. The greatest value of this high mountain forest lies in the protection it gives to the headwaters of important streams.

The lower belt comprises a thinly stocked open forest mostly of oak at the lowest elevations, with a preponderance of scrubby pine at the higher elevations (see Pl. XCI, *A*). Interspersed throughout this growth are strips of valley grass land ranging in size from 100 to 1,000 acres or more. In the southwestern border sections low, broad hills of considerable extent are frequently covered with a dense growth of heath brush.

The trees of this belt are usually low, of small diameter, crooked, and much scattered, admitting everywhere a thick growth of annual grasses.

The middle timber belt is characteristically coniferous. Pines predominate at the lower elevations, but in the higher sections cedar and fir are mingled with the pines in more or less equal numbers. These trees constitute the principal forest growth and are the commercially important features of the belt. As a rule the growth is continuous but rather open (see Pls. XCII, *B*, and XCIV, *B*); there are, however, areas of considerable extent on broad benches where the forest is dense (see Pl. CVI, *B*). The trees are usually of large dimensions. A few small, unimportant broad-leafed trees predominate along streams in the bottoms of canyons, and in some places mingle in extended patches with the general coniferous growth.

The upper forest belt is likewise coniferous in character, but the bulk of this timber is fir, with mingled areas of inferior pines, juniper, and hemlock. The lower elevations, including soil-covered, rocky benches and the mucky borders of subalpine meadows, contain the denser growths, while the bare, rocky, higher elevations have only a very scattered growth of stunted trees (see Pl. XCVI, *B*). The size and quality of the timber in this belt is inferior to that of the middle belt. The firs are the only large trees in the upper region, and these do not compare in size or value with the pines and firs of the middle region.

COMPOSITION OF FORESTS.

The following lists of trees show the various species found in the forests of this region. The appearance of a few species in the lists of two separate regions indicates a wide overlapping, which will be discussed later.

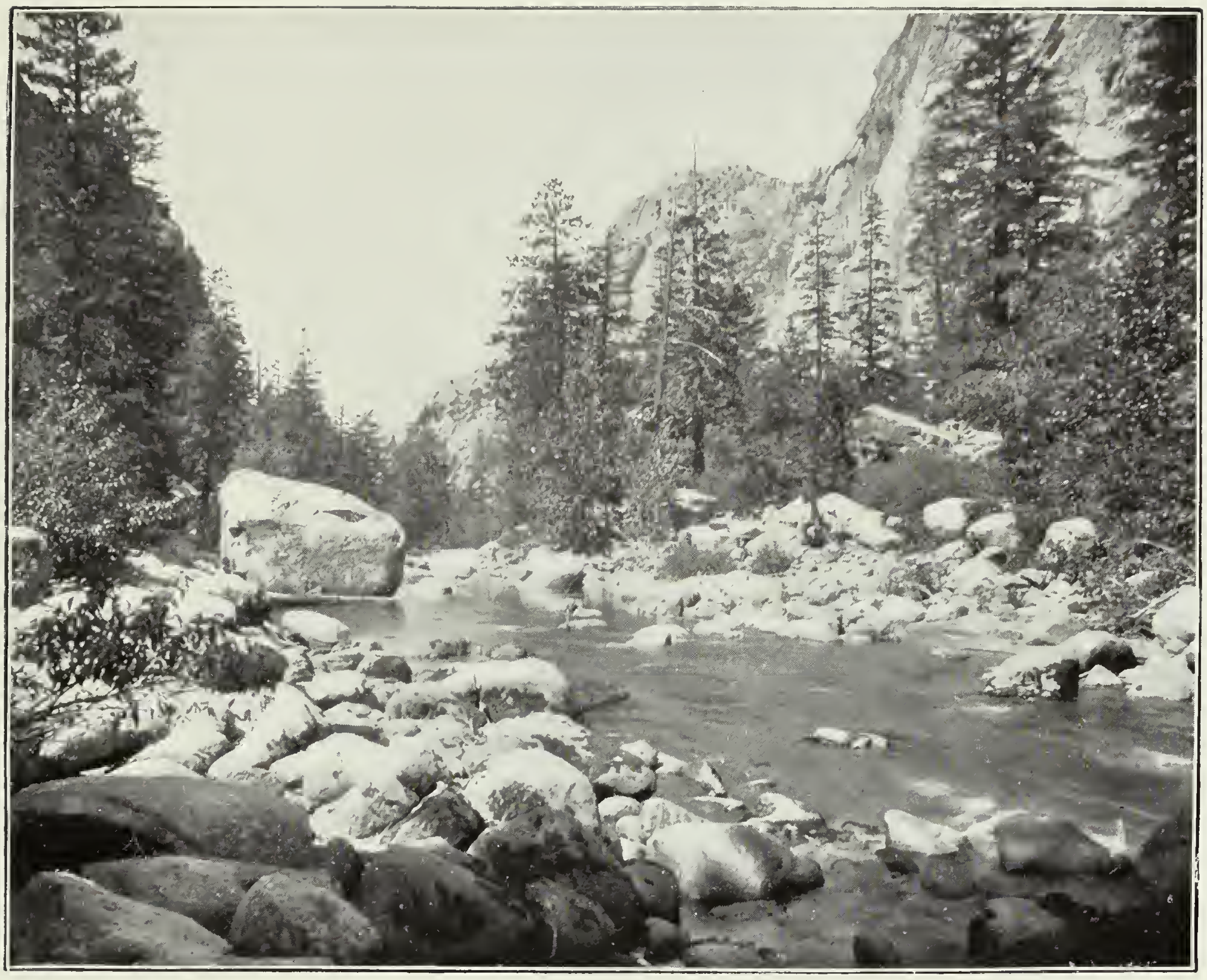
Composition of forest in Lake Tahoe and Stanislaus forest reserves, California.

LOWER BELT.

Gray pine	Pinus sabiniana Dougl.
Western black willow	Salix lasiandra Benth.
Silver-leaf willow	Salix sessilifolia Nutt.
Fremont cottonwood	Populus fremontii Wats.
California white oak	Quercus lobata Née.
California rock oak	Quercus douglasii Hook. & Arn.
Curl-leaf scrub oak	Quercus dumosa var. revoluta Sarg.
Morehus oak	Quercus morehus Kell.
California laurel	Umbellularia californica (Hook. & Arn.) Nutt.
California live oak	Quercus wislizeni A. de C.
Christmas berry	Heteromeles arbutifolia (Poir.) Roem.
Oregon maple	Acer macrophyllum Pursh.
California buckeye	Æsculus californica (Spach.) Nutt.
Coffee berry	Rhamnus purshiana de C.
Oregon ash	Fraxinus oregona Nutt.
Pale elder	Sambucus glauca Nutt.

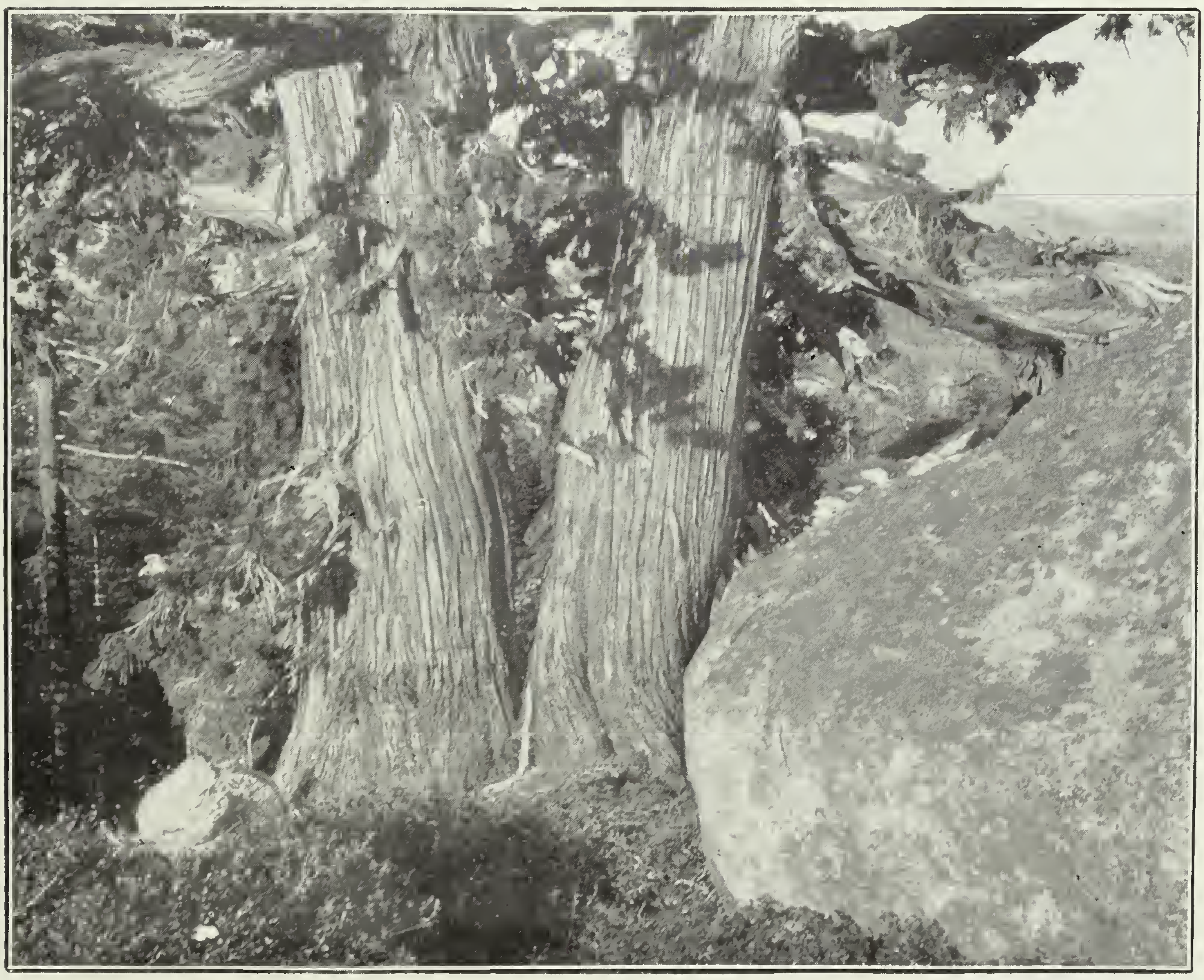
MIDDLE BELT.

Sugar pine	Pinus lambertiana Dougl.
Yellow pine	Pinus ponderosa Laws.
Jeffrey pine	Pinus jeffreyi Oreg. Com.
Red fir	Pseudotsuga taxifolia (Poir.) Britt.
White fir	Abies concolor (Gord.) Parry.
California red fir	Abies magnifica Murr.
Big tree	Sequoia gigantea.
Incense cedar	Libocedrus decurrens Torr.
Pacific yew	Taxus brevifolia Nutt.
California torreya	Tumion californicum (Torr.) Greene.
Black cottonwood	Populus trichocarpa Torr. & Gr.
White alder	Alnus rhombifolia Nutt.
Golden chinquapin	Castanopsis chrysophylla (Hook.) de C.
Canyon live oak	Quercus chrysolepis Liebm.
California black oak	Quercus californica (Torr.) Coop.
Tan-bark oak	Quercus densiflora Hook. & Arn. Quercus densiflora var. echinoides (R. Br. Campst.) Sarg.
California scrub oak	Quercus dumosa Nutt.
Short-flower mahogany	Cercocarpus parvifolius var. breviflorus (Gr.) Jones.
Western chokecherry	Prunus demissa (Nutt.) Walp.



A. CANYON OF MIDDLE FORK OF STANISLAUS RIVER AT DONALDS FLAT.

Looking south from near the mouth of Dardanelles Creek, Stanislaus Forest Reserve.



B. WESTERN JUNIPER (JUNIPERUS OCCIDENTALIS HOOK.) 28 AND 30 INCHES IN DIAMETER.

Northwest border of Stanislaus Forest Reserve.

Pacific plum	Prunus subcordata Benth.
Oregon maple	Acer macrophyllum Pursh.
Coffee berry	Rhamnus purshiana de C.
Pacific dogwood	Cornus nuttallii Aud.
Madroña	Arbutus menziesii Pursh.

UPPER BELT.

Western white pine	Pinus monticola Dougl.
White-bark pine	Pinus albicaulis.
Jeffrey pine	Pinus jeffreyi Oreg. Com.
Lodgepole pine	Pinus murrayana Oreg. Com.
Black hemlock	Tsuga pattonii Balf.
White fir	Abies concolor (Gord.) Parry.
California red fir	Abies magnifica Murr.
Western juniper	Juniperus occidentalis Hook.
Aspen	Populus tremuloides Michx.
Paper-leaf alder	Alnus tenuifolia Nutt.
Bitter cherry	Prunus emarginata (Dougl.) Walp.
Dwarf maple	Acer glabrum Torr.

CHARACTER AND DISTRIBUTION OF SPECIES.

LOWER BELT.

Abundant and Important Trees.

Two species are conspicuous in this belt and deserve special notice. These are the gray pine and California rock oak.

GRAY PINE.

The gray pine is the only pine found in the lower belt, and, together with the California rock oak, forms the conspicuous open tree growth on all the dry, gravelly foothills. Its range in altitude is from 500 to 3,000 feet, the region of greatest abundance being between 1,000 and 2,000 feet elevation. This pine shows a marked tendency to stretch beyond its general limits into the middle pine belt. Straggling lines are thus frequently seen extending beyond the main range, and in a few localities detached groups were found well up among the yellow pine of the middle region.

The gray pine is in no sense a timber tree. Its form is usually scraggy, with a low, much-branched crown and very little clear trunk; in most cases even the largest trees bear stout limbs nearly to the ground. Thirty to forty years ago this pine is said to have been very abundant, of large size, and to have formed continuous forests of considerable density. At the present time, however, the stand is thin and composed chiefly of trees from 10 to 40 feet in height. Occasional old trees, 60 to 80 feet high, are found towering far above the present growth. These are doubtless remnants of the original forest. The common diameter of this species ranges from 12 to 24 inches, while the occasional old trees are from 28 to 37 inches in diameter.

The reproduction of this pine is abundant. Wherever surface fires have not occurred frequently, seedlings spring up rapidly and cover the driest and rockiest hills and shallow valleys.

CALIFORNIA ROCK OAK.

The only conspicuous broad-leaf tree of this belt is the California rock oak (see Pl. XCI, *A*). Like the gray pine, it is not a timber tree. It spreads over the lowest foothills, forming a very open forest, in which scattered low brush and abundant annual grasses thrive. It occurs on the foothills farther westward and considerably outside of the region under consideration. Within this region the distribution is between 300 and 1,500 feet elevation, and is most common between 500 and 1,000 feet. It is rather exclusive, not generally mingling with other species, and then only with the gray pine. Areas, rather than individuals of the two species, are more often mingled.

As a rule the California rock oak occurs on the richer hill soils, occasionally, as stated, sharing poor gravelly and stony sites with the gray pine. Stragglers of this oak are occasionally found within the middle pine belt, especially in shallow valleys or along small streams. The trunks of the California rock oak are short and crooked, and the crown is much branched (see Pl. XCI, *A*). Diameter measurements range from 14 to 24 inches or, exceptionally, 28 inches. The usual height is 25 to 40 feet.

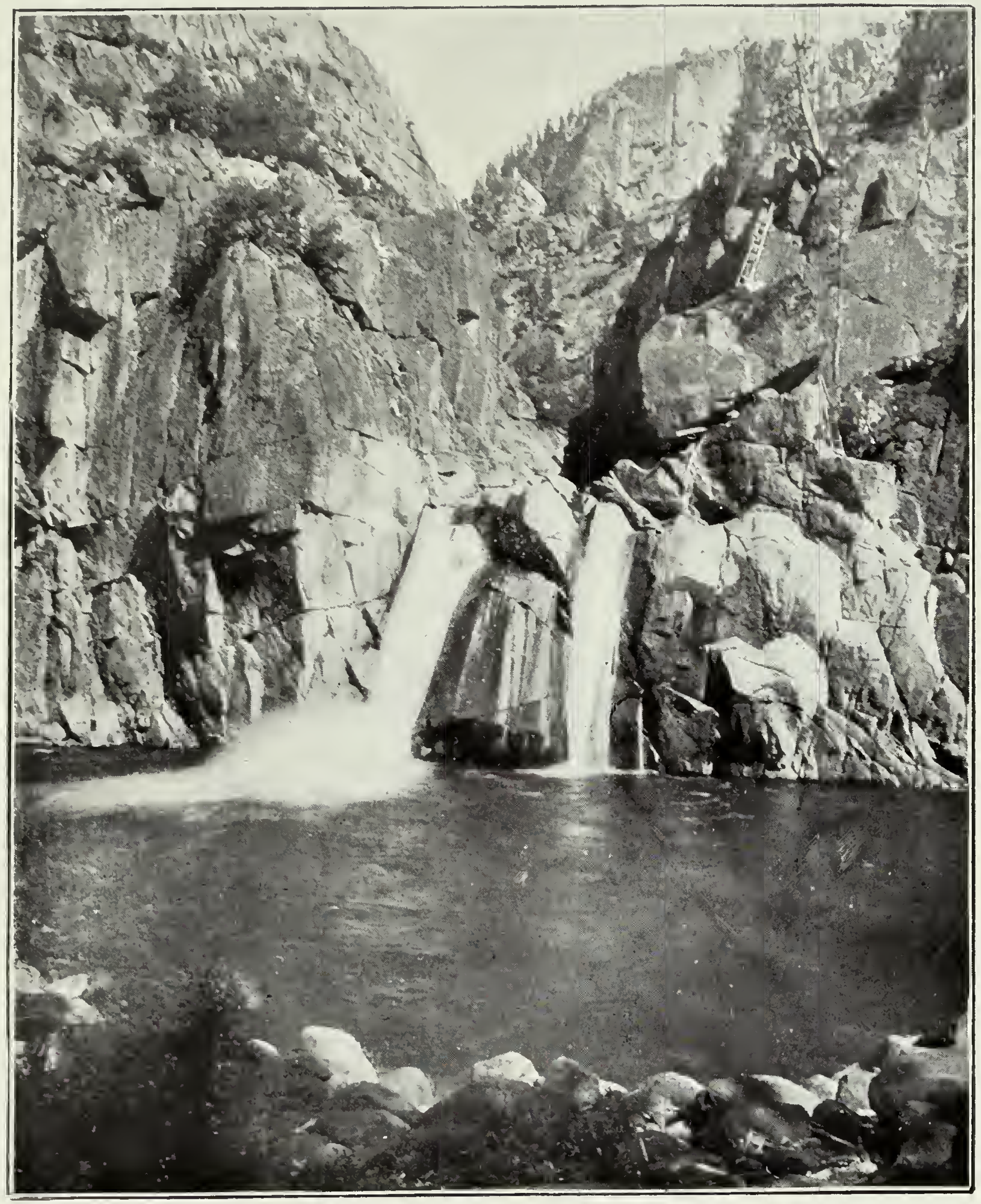
It reproduces itself very persistently, soon taking possession of abandoned or long-neglected ranch land within its range.

Rare or Unimportant Trees.

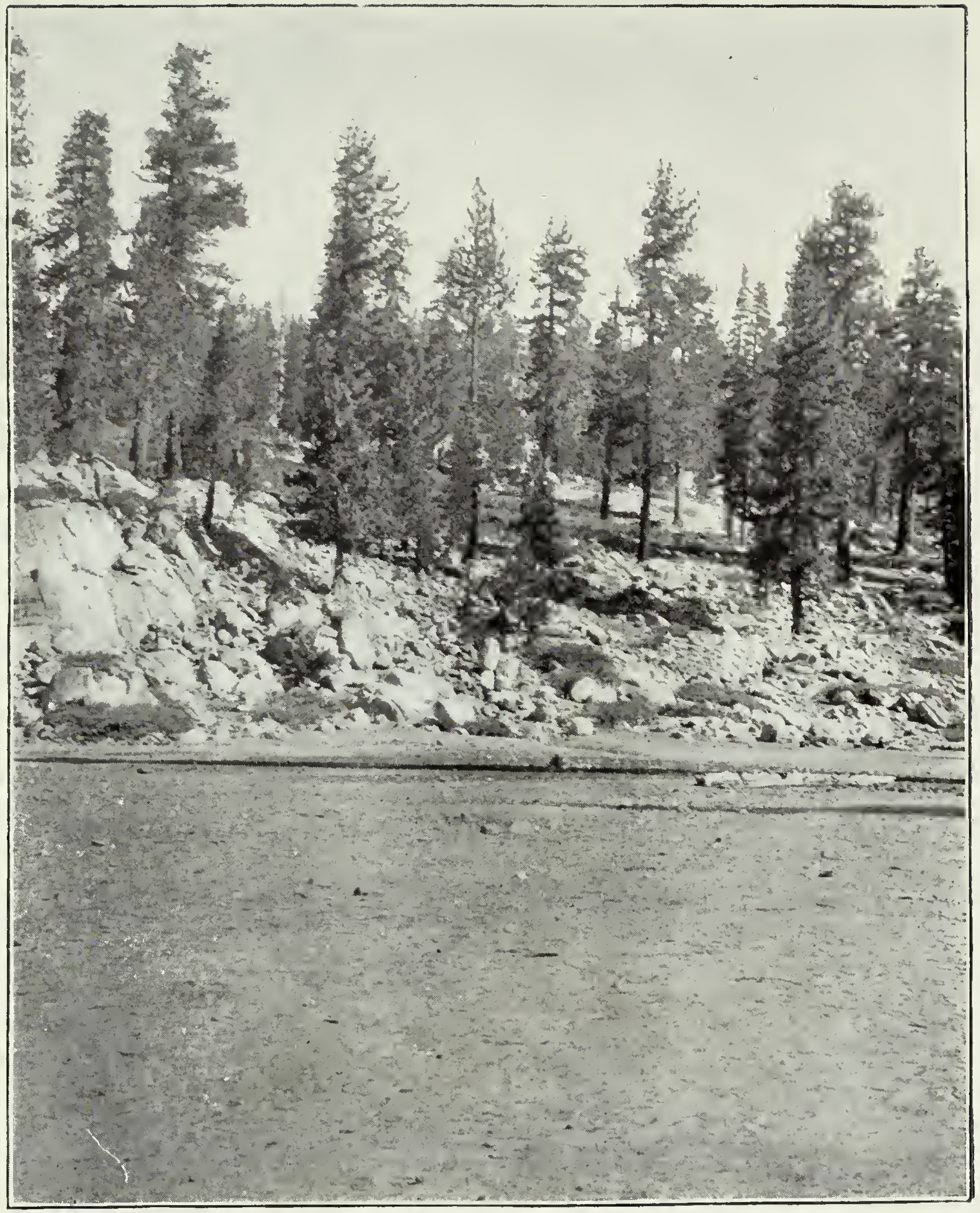
Most of the other sixteen species found in this belt are of such rare occurrence and frequently also of such small size as to deserve only a passing notice. Moreover, the majority are restricted to the courses of streams or the narrow bottoms of dry canyons, and so form but a small part of the general tree growth of the region. The most conspicuous of these species are California white oak and live oak.

CALIFORNIA WHITE OAK.

The California white oak is a tree similar in form to the California rock oak, but is much larger, and is found only in low, rich bottom lands; however, it occurs more extensively to the west of and outside of this region than within it. A number of large trees 2 to 4 feet in diameter were seen on ranches in the vicinity of Green Valley and Shingle Springs, at Pleasant Valley, along the Calaveras River at Jenny Lind, and in the valley of Bear Creek (west side of Bear Mountains). It is said to have been once abundant and to have formed open forests in the above localities; but as it occupied the best agricultural



A. FALLS OF MIDDLE FORK OF STANISLAUS RIVER AT NORTH END OF DONALDS FLAT, STANISLAUS FOREST RESERVE



B. TYPE OF JEFFREY-PINE FOREST, HEADWATERS OF SUMMIT CREEK

lands, it has been very largely cleared off, and is represented now by only a few widely scattered trees, which ranchmen preserve for fuel and shade for stock. Under these conditions there is little reproduction. A few trees of much smaller size, standing far beyond the main range, probably stragglers, were seen also near Garden Valley, Coloma, Lotus, Indian Diggins, Coyoteville, West Point, Glencoe, Railroad Flat, and Sheep Ranch.

CALIFORNIA LIVE OAK.

The live oak also has a greater range westward, outside of this region, but it occurs more or less abundantly in the lower tree belt near the western and southwestern borders. It is confined entirely to ravines, gulches, and creek canyons, and is most common in the region of Bear Mountains, Gopher Ridge, and Bald Mountain. It was seen sparingly on creek canyons from Garden Valley southward to the canyon of the South Fork of American River near Coloma and Lotus. It was seen also on Hangtown and Webber creeks, west of Placerville, but disappeared one-half mile east of the latter place. It likewise appears at Pleasant Valley and southward and in canyons from Indian Diggins westward to Coyoteville and Oleta.

It is always a low, bushy, intricately branched tree from 6 to 18 inches in diameter and 15 to 25 feet high. It prefers dry, gravelly, and rocky soils, and is usually widely scattered.

OTHER SPECIES.

The one other white oak of this region is a rare, inconspicuous shrubby species, 6 to 15 feet high, forming occasional dense thickets somewhat similar to those of the Rocky Mountain scrub oak. It was seen only in the vicinity of Volcanoeville and Georgetown.

Quercus morehus (so-called "black oak") is a very rare species and previously not known to occur in this region. It is reported only from Lake County, California. It is usually associated with live oak. Single trees 20 to 30 feet high and 10 to 14 inches in diameter were seen on a head branch of Canyon Creek (2 miles northeast of Georgetown), on the head of Indian Creek (near Plymouth), on Mokelumne River (west of West Point), several times on Bear Creek Canyon (west side of Bear Mountains), on the head of Murray Creek (2 miles north of Mountain Ranch), and on San Domingo Creek (2 to 3 miles north of Murphy).

MIDDLE BELT.

Abundant and Important Trees.

The trees of this belt form the greater and most valuable part of the forests of the entire region. Five species, the sugar pine, yellow and Jeffrey pine, white fir, and incense cedar, make up the forests of greatest extent, and, with the exception of the rarer and isolated red fir and the giant big-tree, exceed the dimensions of all other trees in the region. In order of abundance the yellow pine ranks first, white fir second, incense cedar third, sugar pine fourth, and Jeffrey pine fifth.

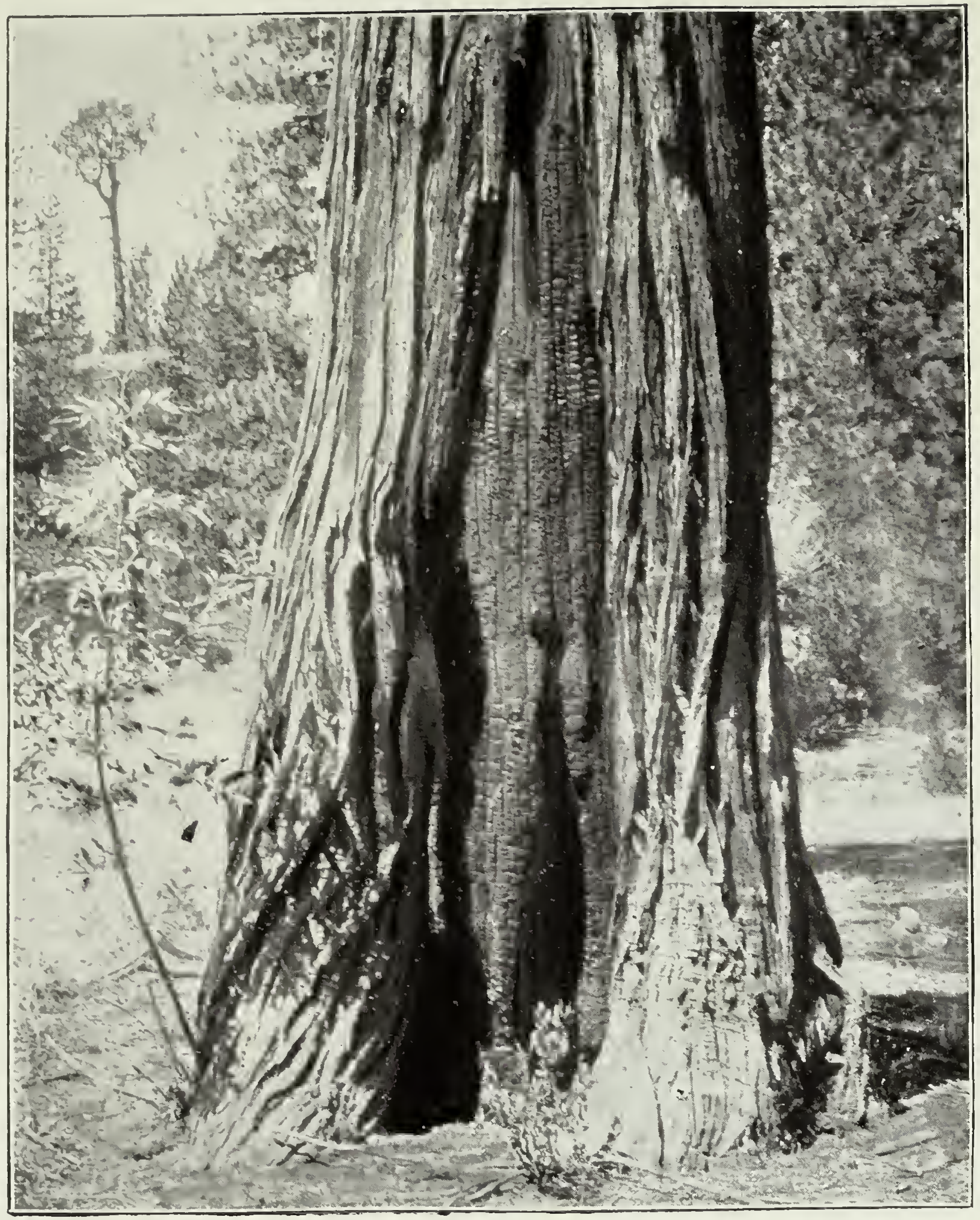
Of equal or of nearly as great commercial importance, but of less common occurrence, are the red fir and big-tree. The big-tree attains the greatest dimensions of all cone bearers in this region, and on this account is the most widely renowned of Sierra forest trees. The red fir ranks in size with the other large timber trees of the territory, but has a limited range here and is the least abundant of this group.

YELLOW PINE.

This species is the most abundant and the second largest pine in the middle belt. The area over which it grows ranges in altitude from 2,000 to 6,000 feet, while the region of greatest abundance and best development lies between 3,000 and 5,000 feet elevation. The relative amount of yellow pine in the average stand varies considerably throughout the altitudinal range of the species and also in different localities at the same level. Large areas, however, especially at the middle and lower levels, often contain 80 to 90 per cent of yellow pine. For the most part, however, there is a larger admixture of incense cedar, white fir, and sugar pine, the yellow pine amounting to from 45 to sometimes 50 per cent.

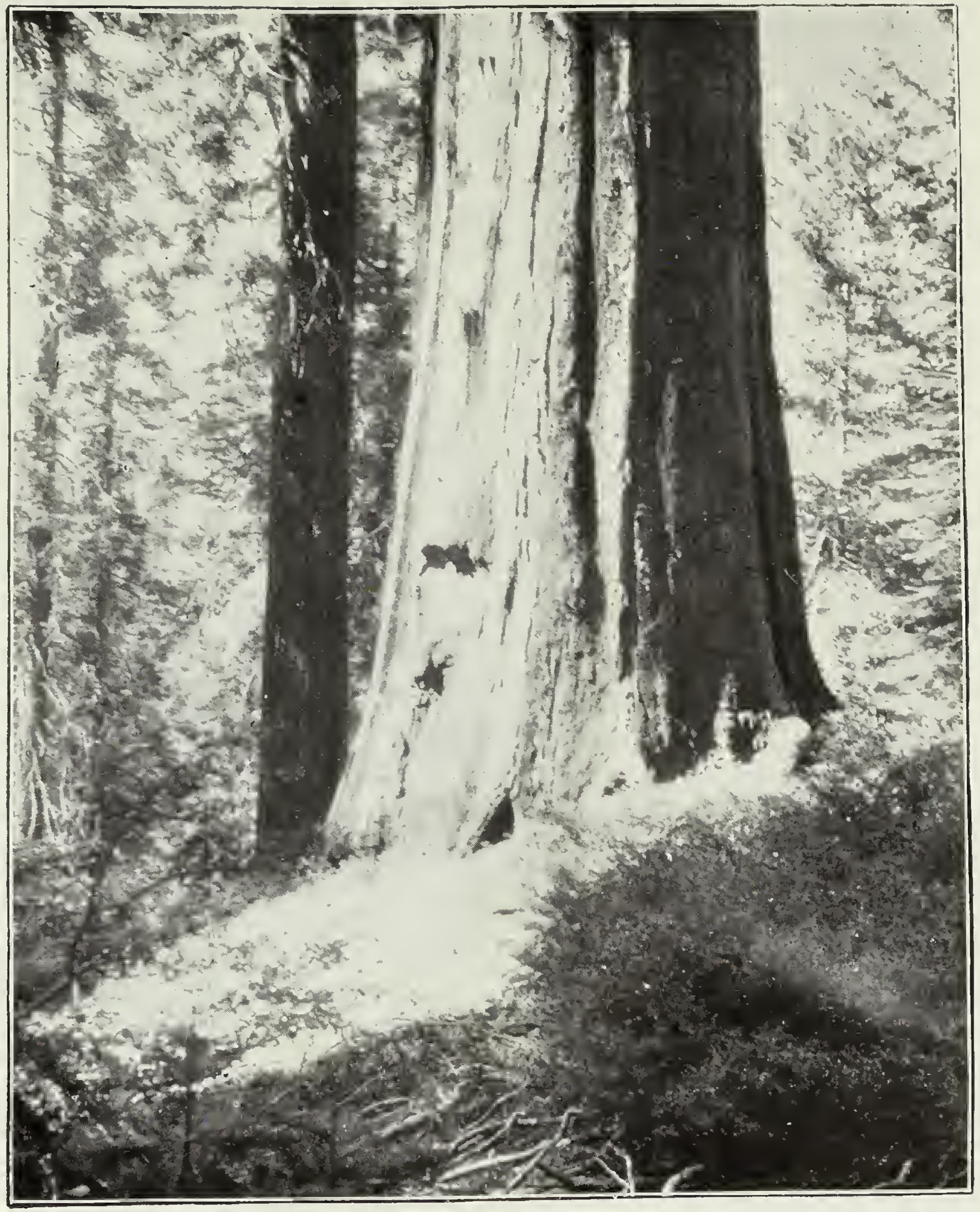
Yellow pine is very adaptive in point of soil and situation. It appears to be most common on southern, eastern, and western slopes, but in some localities is found also on northern slopes. It grows vigorously and attains large dimensions in the poorest gravelly clays or in the crevices of bare, rocky mountain or canyon sides (see Pl. CVI, *B*). The largest and finest timber trees are, however, found growing on rich sandy or gravelly loam benches of from one to several hundred acres in extent on the principal river and lower mountain slopes. Forests of large, mature timber are rarely if ever dense; the single big trees, or groups of three to six trees, stand far apart, forming a characteristically open forest (see Pl. XCII, *B*). Younger forests, 40 to 60 years old, are often very dense, but later these become open by natural thinning, excessive shade, and frequent fires. The common height of yellow pine is from 150 to 180 feet, with a diameter of from 3 to 4 feet; exceptionally large trees are 185 to 190 feet high and 6 to 7 feet in diameter. The maximum age reached is 500 to 520 years, but such trees are rare; the average age is from 250 to 350.

The reproduction of this pine is remarkably persistent and abundant wherever it is not checked by fires and the excessive trampling of grazing herds (see Pls. C, *B*, CI, *B*, and CXII, *B*). The frequent open

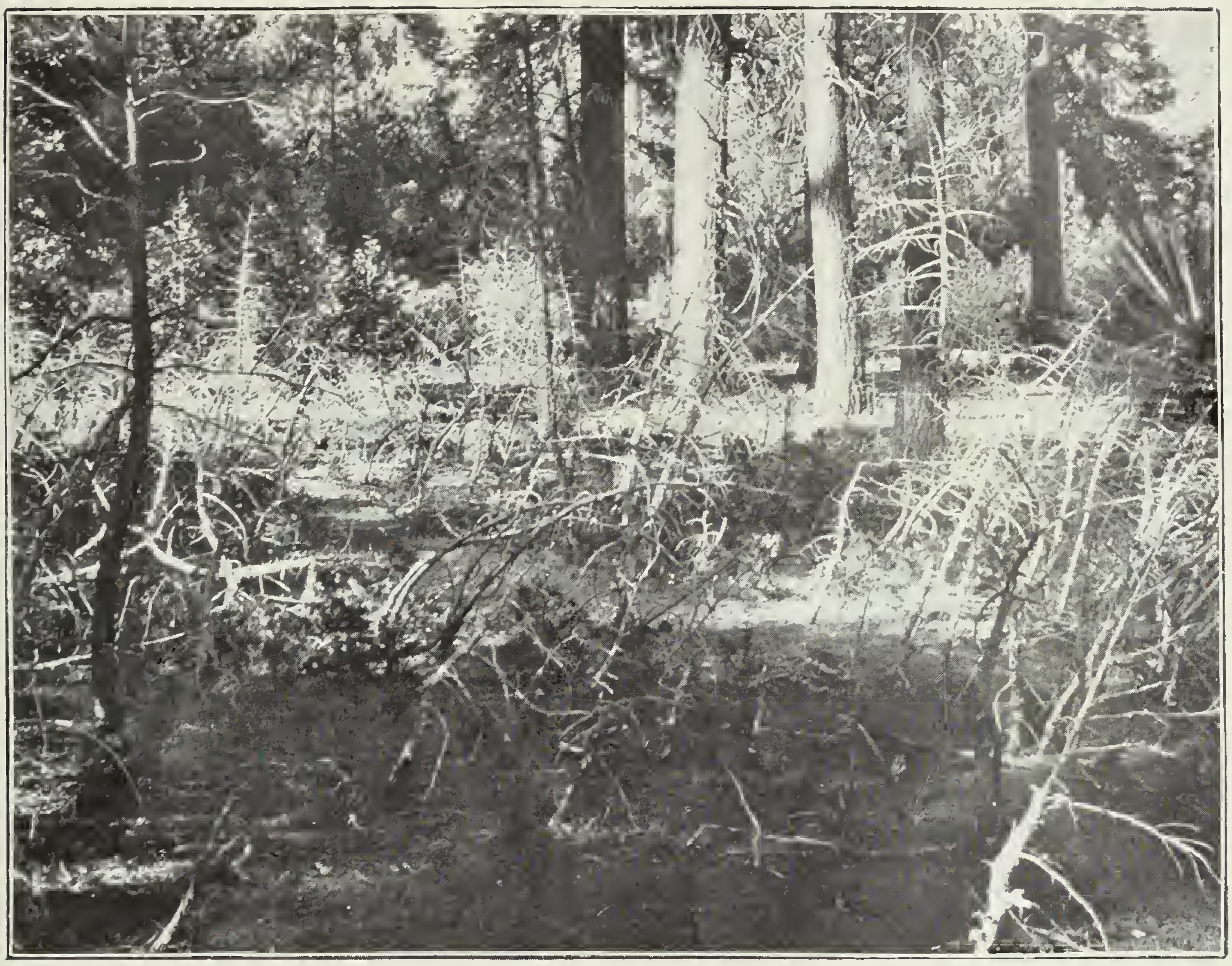


A. INCENSE CEDAR (LIBOCEDRUS DECURRENS TORR.) 50 INCHES IN DIAMETER, SHOWING THE EFFECTS OF ANNUAL BURNING.

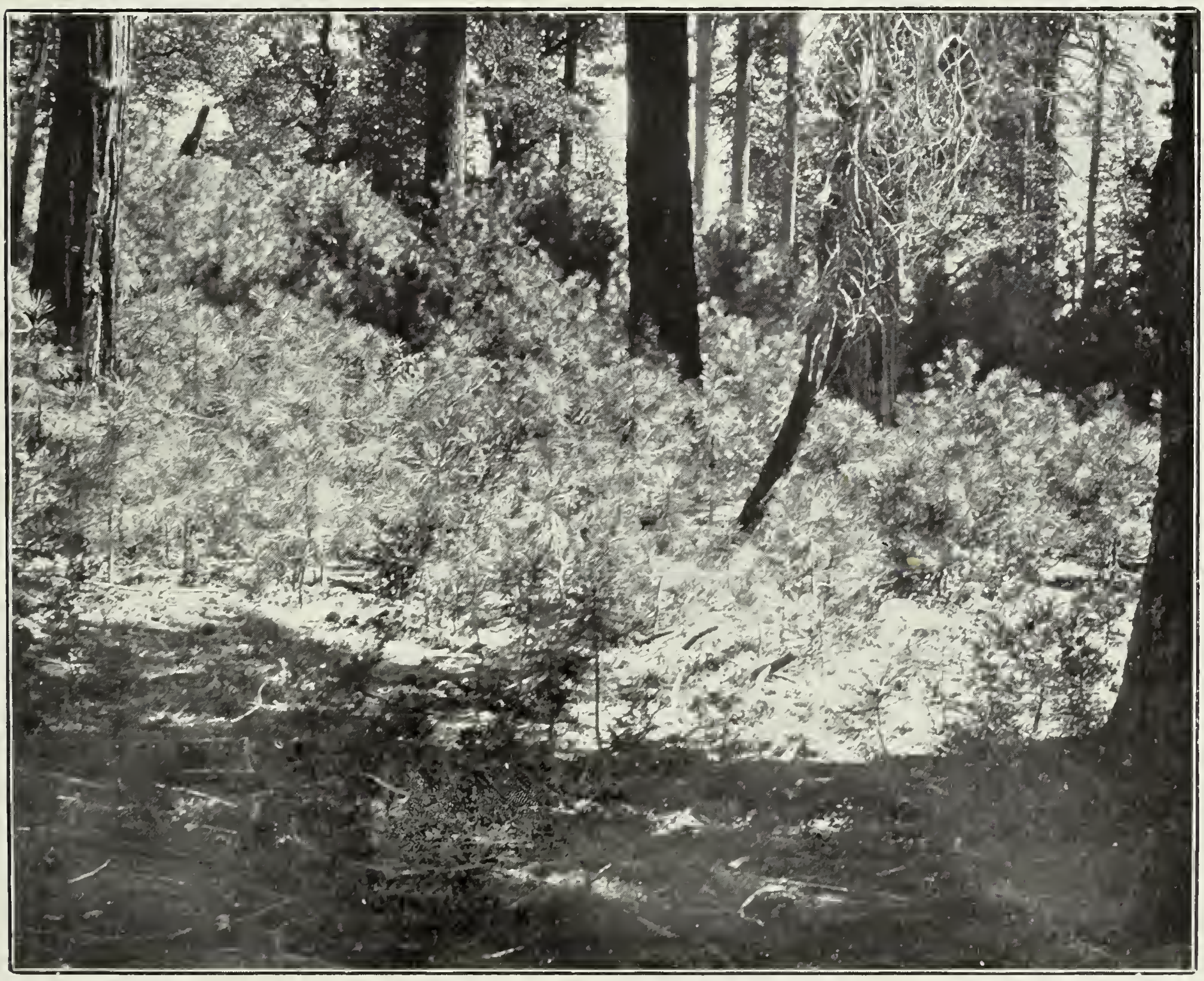
Near Dry Meadows, on headwaters of Soap Creek.



B. TRUNK OF BIG TREE (SEQUOIA GIGANTEA), TUOLUMNE BIG-TREE GROVE.



A. YOUNG GROWTH OF YELLOW PINE, WHITE FIR, AND INCENSE CEDAR KILLED BY SURFACE FIRES, NEAR MOUTH OF SOAP CREEK.



B. ABUNDANT REPRODUCTION OF YELLOW PINE ON MIDDLE FORK OF STANISLAUS RIVER.

spaces in yellow-pine forests are sooner or later covered with dense patches of young trees, but these thickets may in turn be swept off by fire. So continuous and widespread are these forest fires that, except where some natural barrier or chance has prevented, they keep a very large percentage of the seedling growth down. Hence, with the added damage done by other agencies, the general impression is that there is little reproduction of this pine. The forest floor looks clean swept. But the remarkable reproductive power of this pine is seen only in localities where fences and the exclusion of fire have protected the incoming seedlings. Here the stand is so dense as to be quite impenetrable. Cut-over lands thus protected are quickly reclothed with yellow pine. It is believed, therefore, that except in the few localities where this pine has been cleared and kept down the area originally claimed by it is very largely the same as that over which the tree now grows. Necessarily the amount of commercial timber has been greatly reduced on an area formerly well stocked, but the power of this pine to hold its own is unsurpassed by any other associated species.

INCENSE CEDAR.

Incense cedar is an abundant tree in these forests. It is closely associated with the yellow pine, but reaches a higher altitude, occurring at elevations of from 2,000 to 7,000 feet. It is most common between 3,500 and 5,500 feet, where it forms from 20 to 30 per cent of the total stand, while on occasional small areas it may be the prevailing tree. Like the yellow pine, the older growth of incense cedar appears in an equally open stand, having to suffer in common with the pine, and with equal resistance, the thinning effects of fire. While following the pine closely in point of soil and slope, the cedar descends, more often than the pine, into the bottoms of canyons, where it sometimes shares the moist, rocky banks of streams with red fir, alder, and cottonwood.

The trunk form of incense cedar is strongly conical, and appears in marked contrast to the cylindrical boles of the yellow pine. The taper of large cedar trunks ranges from 4 to sometimes 6 inches in 16 feet. The height attained is small compared with the proportionately greater diameter. Mature trees are 80 to 100 feet in height and 4 to 7 feet in diameter. It is a comparatively short-lived tree, as it attains these dimensions in from 100 to 260 years. Old trees are quite generally dead or damaged at the top, and lack the thrifty appearance of younger trees, or even of much older pines and firs on the same ground (see Pls. XCIX, *A*, and CXIII, A).

The reproduction of incense cedar appears to be equal in abundance to that of the yellow pine, especially in the drier situations; but, as already stated, the cedar is far less abundant as a mature forest tree than the pine. This may be accounted for, however, by the fact that being fragile and diseased in middle and old age it succumbs more rapidly than the pine to high winds. Otherwise it is difficult to explain the persistent and abundant reproduction of cedar everywhere visible in the range of the species.

SUGAR PINE.

The sugar pine is quite generally distributed throughout the middle timber belt, but is the least common species of pine over the entire area. There is evidence, however, that formerly it was considerably more abundant than now, and also that it once occupied areas from which it has since nearly or entirely disappeared. Undoubtedly the high commercial value of the timber for certain purposes and the comparatively less prolific reproduction of this pine must largely account for this reduced quantity of the timber and its total disappearance in some localities. The reduction and thinnings referred to took place chiefly along the western border of this timber belt, nearest to the settled districts.

The range of sugar pine in altitude is from 2,000 to 7,000 feet. Only straggling small trees represent the species at the lower elevation, while stunted, scattered trees are found at the higher elevation. The area of greatest abundance and finest growth lies between 3,000 and 5,000 feet. Sugar pine is nowhere common. At most it forms 5 to 20 per cent of the total stand, while in a few exceptionally favorable situations small areas contain 20 to 25 per cent sugar pine. Large stretches of forest possess only occasional trees. Like the white pines, the sugar pine is partial to north slopes and to the protected coves, broad valleys, and mountain benches of southern and western slopes; it is found also on the summits of low mountains. This pine thrives under practically the same soil conditions as the associated yellow pine and incense cedar, but it usually seeks the moister and richer sandy or gravelly loam soils, where the largest and best-grown trees are found. Of all the pines in this region, it is the tallest and attains the greatest diameter. The usual height is from 180 to 200 feet, and in exceptional trees 210 to 218 feet. Diameter measurements range from 4 to 6 feet, or exceptionally from 6½ to 8 feet. The trunks are clear of branches for 60 to 100 feet and are cylindrical (see Pl. XCVI, *A*). Mature trees are 350 to 400 years old, while the oldest tree found was 515 years.

The reproduction of sugar pine is evident throughout the range of the species. Moderate numbers of seedlings and saplings are always to be found in the vicinity of old trees and are usually mingled with the young growth of other timber trees. There is a marked difference between the persistent, prolific reproduction of yellow pine and the slower, less aggressive advance of the sugar pine. The former readily takes possession of dry, exposed sites, while the latter establishes itself more often on moister, protected places; and when it takes to drier situations, it is usually after the hardier yellow pine and cedar have gained a foothold. Once established, however, the young trees show every ability to hold their own, being rarely crowded out after they attain a height of 6 to 10 feet. They usually soon pass the more numerous yellow pines in height, and remain above them to the end. It is interesting to note, in connection with the limited reproduction of sugar pine, that in addition to the common destruction of seedlings by fires, the paucity of its numbers is due also to a comparatively small seed production. Moreover, there is usually a longer interval (two to three years) between the seed years of sugar pine than between the seeding years of the yellow pine. The latter also produces larger quantities of seed. Besides, the big, rich, nut-like seeds of the sugar pine appear to be eaten more frequently by squirrels than are the smaller yellow-pine seeds.

WHITE FIR.

Two firs, the white fir and California red fir, occur in this timber belt. The former is of greater commercial importance, both on account of its more general distribution with the three preceding species and also on account of the superior quality of the timber. This fir is more or less closely associated with yellow pine, incense cedar, and sugar pine in the eastern part of their range, but does not descend to as low an altitude as these species; as a straggler, however, in the upper timber belt it reaches a higher altitude than any of them. It appears in limited numbers at an elevation of about 3,800 feet and extends up to 7,500 feet. As a timber tree it is common only from about 4,000 feet up to about 5,500 feet elevation. It grows under practically the same conditions as the yellow pine and incense cedar, but is more partial to the situations and soil chosen by the better growth of sugar pine. As a rule, therefore, it is a closer associate of this species than is either of the above trees. It forms from 30 to 45 per cent of the stand over the area of its greatest abundance. On small benches of southern slopes near the lower limit of its range areas may be found where, alternating with those containing an almost pure growth of yellow pine, the stand of white fir amounts to 50 or 60 per cent; the remaining stand is usually yellow pine with a small percentage of incense cedar. The occurrence of so large a percentage of white fir is, however, not general, but rather exceptional, and is mentioned only to show more fully the character of the species.

The trunk form of this fir is cylindrical and straight throughout. The crown is small and narrow, often leaving a clear trunk 40 to 80 feet long, or with only an occasional branch. The common height of mature trees is from 175 to 190 feet; in exceptional cases a height of

200 feet is reached. Diameter measurements range from 3½ to 5½ feet, or very exceptionally 7 feet. Large trees are from 300 to 380 years old.

The reproduction of white fir is very general over the range of the species, and in some sections the young growth is exceedingly abundant. Thickets of seedlings and saplings are often found covering many acres, and to the exclusion of all other species. In locations where other young growth is present the white fir may comprise 40 to 60 per cent of the whole growth. The wonder is that mature trees of this species are not more abundant. But when fires occur, the richly resinous foliage and branches of the young growth suffer more severely than the pines or cedars. Owing to thinness of foliage and less resin, a few of the latter may escape fatal burning; but it is rare that any of a low thicket of firs ever survives even a surface fire. Moreover, the rather small seed production of this fir, and also the long intervals between seed years, has much to do with the frequency at which burned stock is replaced by reseeding.

JEFFREY PINE.

As a commercial tree this pine need not be separated from the yellow pine, as the timber of both is practically the same. Lumbermen and woodmen readily distinguish the two trees, but the lumber of both passes for yellow pine. Without referring to the botanical status of Jeffrey pine as a distinct species or, as some would have it, a variety of yellow pine, the distribution of this tree is interesting. It appears sparingly near the southeastern section of this region at an elevation of 5,000 feet and extends up to 8,500 feet. Between 5,000 and 6,000 feet it is a large timber tree; but above the latter level it is stunted and of little commercial value. From its marked abundance between 6,500 and 8,500 feet this tree appears to belong more properly to the upper timber belt. Its occurrence in the middle belt is little more than straggling, at most constituting not more than 5 per cent of the total stand. It is, moreover, not generally distributed over the middle belt, appearing irregularly and only at wide intervals; while in the upper belt Jeffrey pine is one of the prevailing trees. In its lower range, Jeffrey pine is associated with yellow pine, sugar pine, and white fir on the richer mountain benches, or on the rich borders of mountain meadows (see Pl. XCIII, *A*). In its higher range, Jeffrey pine grows almost entirely in the crevices of granite. It is often much scattered, but is met everywhere, taking the place of the yellow pine in this high, rocky region (see Pl. XCVI, *B*). When not the sole or principal tree it is mixed with western juniper, silver pine, lodgepole pine, and groups of California red fir. But for the bare, soilless surface of these rocky summits, Jeffrey pine would doubtless form forests comparable with those of the yellow pine of lower levels. For wherever in protected hollows or little rocky plateaus disintegrated rock has formed a soil cover, dense stands of Jeffrey pine are always found. The patches of Jeffrey pine seen on the small sandy and gravelly plains among the high mountains to the west and southwest of Lake Tahoe give splendid illustration of this forest-forming tendency in high altitudes wherever sufficient soil is present. As a timber tree, Jeffrey pine reaches a height of 125 to 160 feet or more, with a diameter of 3 to 5 feet. The trunks of these trees are usually straight, cylindrical, and free from branches for 50 to 60 feet. The age of this timber is from 200 to 350 years. Jeffrey pine of the upper tree belt is generally low and stunted, rarely exceeding 40 or 50 feet in height and 2 or 3 feet in diameter. The age of such trees is from 150 to 200 years. Evidently, from the extremely unfavorable conditions under which this tree exists, it is much shorter lived than trees in lower and more protected situations. It suffers considerably from the high winds which sweep over these rocky slopes, as they frequently tear it from its scanty hold in crevices.

The reproduction of Jeffrey pine is observable everywhere in the vicinity of old trees in its lower range, but is nowhere abundant. In higher altitudes, however, seedlings and young trees are frequent. Reference has already been made to the thickets of this pine west and southwest of Lake Tahoe, where the full capabilities of the tree are to be seen. It shows the same vigorous and persistent reproduction in high altitudes that yellow pine exhibits at lower levels.

RED FIR.

On account of its limited range and sparing occurrence in this belt, the red fir is of only secondary importance as a timber tree. Its original range here was probably not much greater than now, but evidently considerable large timber, represented now by young trees, was cut out long ago. The present value of red fir depends entirely on its occurrence with other more abundant timber trees with which it may be profitably lumbered. In has a range in altitude from 2,000 to 5,500 feet. Between 2,000 and 3,000 feet elevation it is inferior in size, widely scattered, and appears chiefly on the steep north slopes of river canyons, while between 3,500 and 5,000 feet it becomes more abundant and is a large timber tree. From 5,000 to 5,500 feet red fir is much reduced in size and only occurs scattered along rocky river and creek canyons from the water's edge up to 500 or 1,000 feet above. The general distribution of this species is exceedingly irregular and there is little or no connection between the areas of growth. Two localities are worthy of special notice, as they include about all the commercial timber found in the entire region. They are located at points 20 to 25 miles northeast and southwest of Placerville. The first area lies to the south and east of Mutton Canyon. The second area lies between Grizzly Flat and Indian Diggins, and is more or less connected by straggling growth with a third small area southeast of Indian Diggins, on Mill Creek (tributary of North Fork of Mokelumne River). These stations are accessible for lumbering the red fir with other timber, while most of the other points at which the species occurs are inaccessible or too remote from pine timber with which it could be lumbered.

Where most abundant, red fir is usually associated with sugar pine, yellow pine, incense cedar, and white fir, in sandy or gravelly loam soils. Here it represents from 2 to 5 per cent of the stand. Areas of one-half to 1 acre may be found, however, where red fir amounts to 40 per cent or more. The trunks of the best trees are straight, free from branches for 50 to 75 feet, but taper quite rapidly from a widely buttressed base. The height is from 150 to 175 feet, and the diameter is from 4 to 7 feet, while the average age is 350 years. The scattered growth of red fir is from 75 to 100 feet high and 2 to 3 feet in diameter, the trunks generally bearing limbs near the ground.

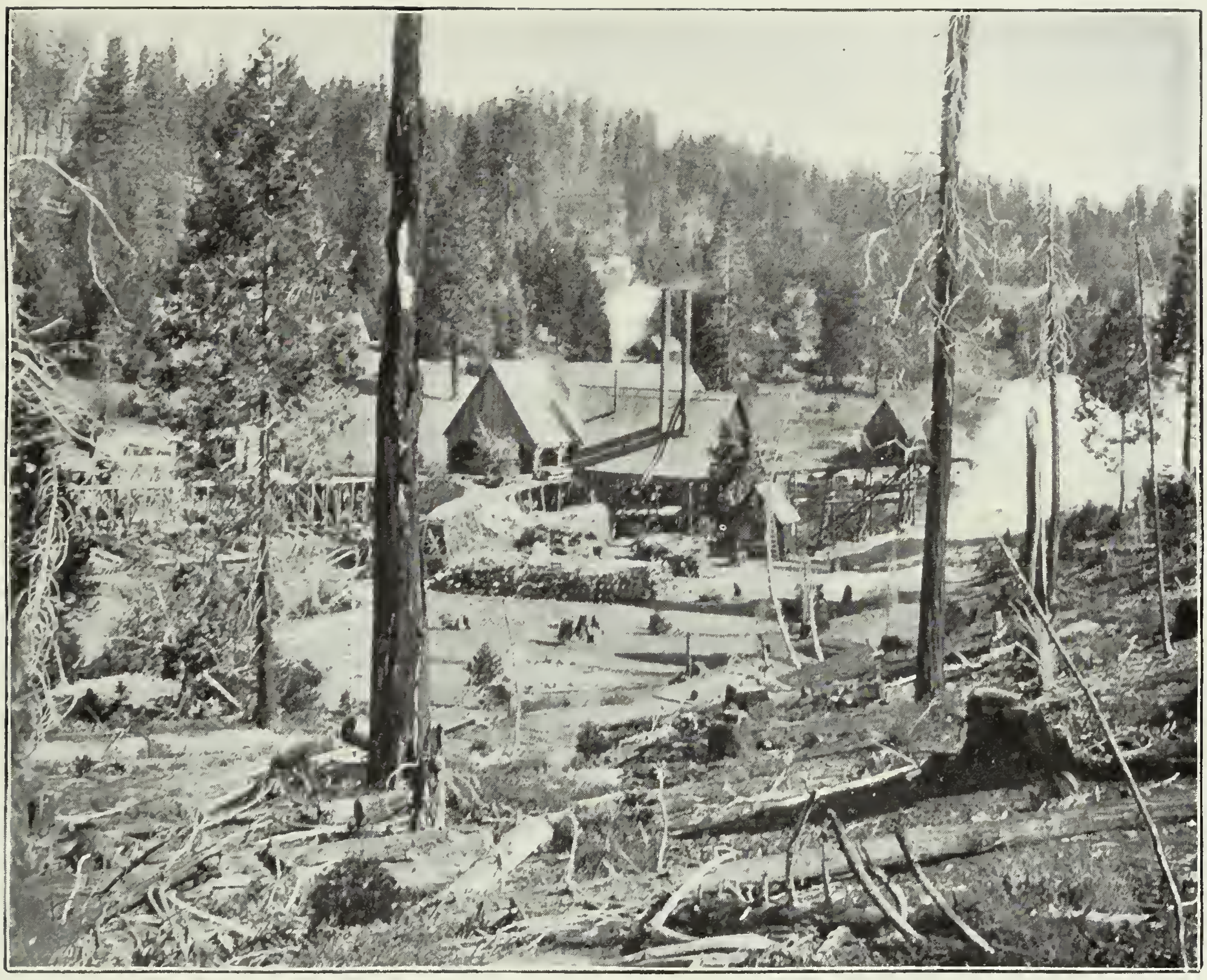
Red fir shows but little reproduction in the region of its best growth, only occasional seedlings or young trees being seen among the greater abundance of pines and cedar. Young growth is much more frequent on the sides of rocky canyons where the old trees are scattered. Red fir, however, does not seed frequently, and the forest trees bear much less seed than the larger crowned trees of the canyon.

BIG TREE (SEQUOIA).

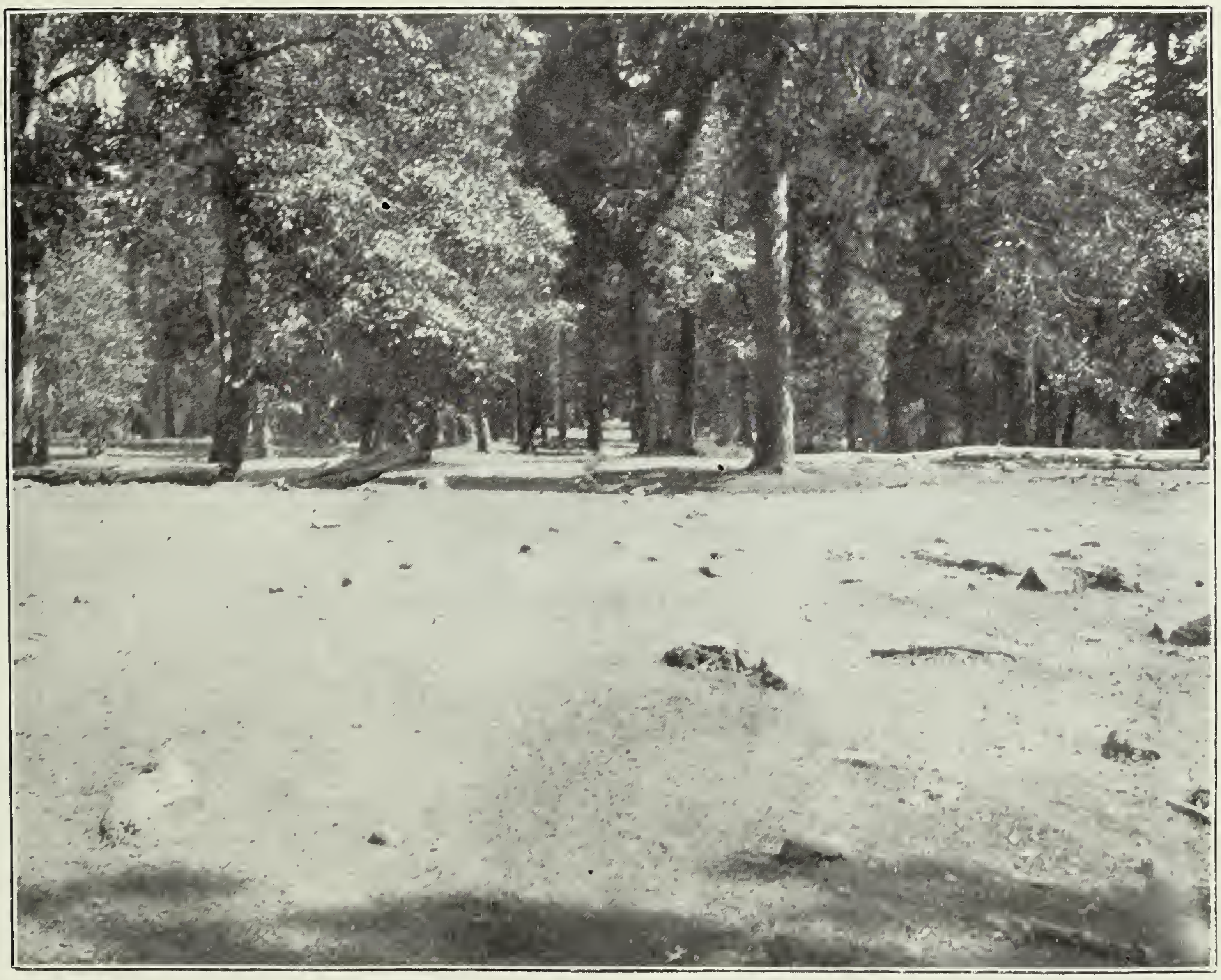
The big tree is the largest conifer found in the middle timber belt, in fact, within the United States. Concerning the general history of this species it may be briefly stated that it grows only on the west slope of the Sierra, and is restricted in its distribution here to eleven more or less isolated groves. These groves extend from the southern border of Placer County southward for a distance of about 260 miles. The elevation of the groves is from 4,600 to 8,400 feet. The northernmost grove is the smallest, consisting of only six trees, while the other groves are much larger, comprising from one thousand to several thousand trees, the southernmost groves being the largest. Most of the groves were discovered between 1841 and 1870. Their exact location, however, and their full extent can hardly be said to be satisfactorily determined even now. Beginning at the north, the names of these groves are as follows:

Big-tree groves in California.

North grove.
Calaveras or "Mammoth" grove.
Stanislaus or "South Calaveras" grove.
Tuolumne grove.
Merced grove.
Mariposa grove.
Fresno grove.
Dinky grove.
Kings River grove.
Kaweah River grove.
Tule River groves.



A. SAWMILL NEAR HEADWATERS OF LOVE CREEK.



B. EFFECTS OF ANNUAL SURFACE FIRES AND EXCESSIVE GRAZING IN PREVENTING ALL REPRODUCTION, HEADWATERS OF JESUS MARIA CREEK.

Two of these, the Calaveras and Stanislaus groves, are included in the territory under consideration. The Calaveras grove is situated at the post-office Big Trees and is the smaller grove. The Stanislaus grove, also called "South," or "South Calaveras" grove, is the larger, and is situated about 6 miles southeast of Big Trees, south of the North Fork of the Stanislaus River, and on a high divide between Beaver Creek (on the north) and Griswold Creek (on the south), both tributaries of the above-named river. The elevation of the Calaveras grove is about 4,600 feet, and that of the Stanislaus grove about 5,000 feet. The former occupies 50 acres and contains about 100 trees; while the latter includes about 1,000 acres with 1,380 trees.

Historically these two groves appear to be the most widely known, most of the popular literature extant relating to them. The Calaveras grove is said to have been the first one discovered; but there is considerable doubt as to the exact date, and also as to the name of the discoverer. John Bidwell—afterwards candidate for Congress from California—is credited with discovering the grove in 1841, while a more current story is that a hunter, A. T. Dowd, found the grove in 1852. It is not definitely known when the Stanislaus grove was discovered.

Many of the trees, standing and prostrate, in both groves are named or marked with marble tablets which bear the names of States, distinguished statesmen, generals, scholars, and other people of note. Seventy-five standing trees of the Calaveras grove are named as follows:

Names of big trees in Calaveras grove, California.

Two Sentinels.
U. S. Grant, named in 1865.
W. T. Sherman, named in 1865.
J. B. McPherson, named in 1865.
Pride of the Forest, once named The Eagle.
Daniel Webster.
Phil Sheridan.
Mother of the Forest.
Three Graces, three trees standing in close line.
Henry Clay.
Andrew Johnson, named in 1865.
Florence Nightingale, once named Nightingale; named in 1865 by a nephew of the English lady.
Bay State.
W. C. Bryant, named in 1865 by a lady, an admirer of the poet.
W. H. Seward.
Pioneer's Cabin, named from the cabin-like chamber and chimney formed by its hollow trunk.
Pluto's Chimney, hollowed out on one side by fire for 90 feet above ground.
Quartette; a cluster of four trees.
America, named in 1865 by a San Francisco lady.
California, once called Ada; named in 1865.
Broderick, once called Mary; named in 1865.

Henry Ward Beecher.
Abraham Lincoln, once called Hermit.
Elihu Burritt.
Uncle Sam.
Alta (Upper) California.
Union.
General Wadsworth.
The Twins.
General Sutter. The trunk divides at 30 feet above ground and forms two trunks.
Salem Witch.
Longfellow.
Prof. Asa Gray.
Dr. John Torrey.
The Trinity; three trees from one trunk, the circumference of which is 60 feet.
Starr King.
Richard Cobden.
John Bright.
Daniel O'Connell.
Edward Everett.
General Scott.
Keystone State.
Sir John Franklin, } Named in 1862 by Lady Franklin.
Dr. Kane, }
Century, named in 1865 in honor of Century Association, of New York, of which the poet Bryant was president.
John LeConte.
Joseph LeConte.
Sequoia Queen, } A cluster of three, the Queen in the center.
Maids of Honor, }
Sir Joseph Hooker, named in honor of the English botanist.
John Lindley, named in honor of the English botanist who was the first to name and describe the big-tree.
Mother and Son; a large and small tree together.
Old Bachelor.
James King of William.
Kentucky.
The Siamese Twins.
Granite State.
The Old Republican.
General Jackson.
Vermont.
Empire State; 94 feet in circumference.
Old Dominion.
George Washington.
Uncle Tom's Cabin.
The Beauty of the Forest.

Several very large trees in this grove have been blown down and one has been cut down; but the wood being of very lasting character, the trunks are still in a fair state of preservation and will remain intact for a long time. These trees are named as follows:

A.

B

CALAVERAS BIG-TREE GROVE.

Names of big trees blown down in Calaveras grove, California.

Father of the Forest, cut down in 1853.
Miner's Cabin, blown down in 1860.
Fallen Monarch, fell probably fifty or more years ago.

Twenty-five standing trees in the Stanislaus grove are named as follows:

Names of big trees in Stanislaus grove, California.

Columbus.
New York.
Correspondent
Fred.
Electra.
Ohio.
Grand Hotel.
Smith's Cabin.
General Custer.
Sir Francis Hucks.
Dr. J. W. Dawson.
Two Lovers.
Massachusetts.
General Garfield.
Hancock.
Grover Cleveland.
Mrs. Grover Cleveland.
Cyclops.
Palace Hotel.
Knight of the Forest.
The Three Graces.
Noah's Ark.

The notable fallen tree of this grove is Old Goliath.

The big tree is always associated with yellow pine, sugar pine, white fir, and incense cedar, but more commonly with sugar pine and white fir. Clusters of two to four trees are frequent, and often several of these are found in close proximity, but in general the big tree is much more scattered, and forms from 1 to 3 per cent of the total stand. The forests in which it occurs are somewhat denser than elsewhere in the middle timber belt, a fact which is accounted for by the exceptionally rich, deep soil and the protected sites where the big tree grows (see Pl. CII, *A* and *B*). Conditions elsewhere similar to these are conducive to the greatest density of the same pines and fir, which are here associated with the big trees.

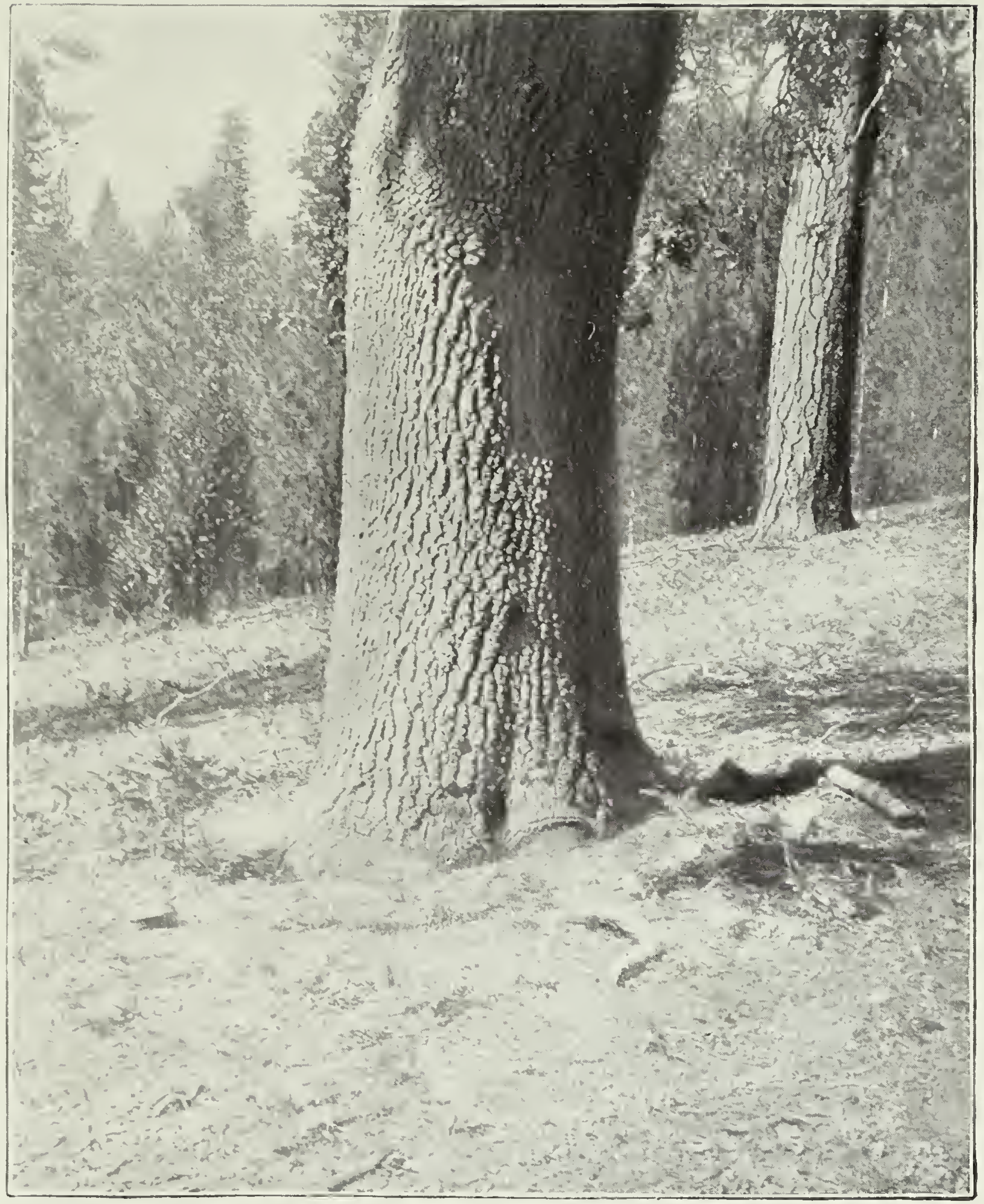
The big tree of these groves grows on northern, southern, and western slopes of gentle incline, and also in the inclosed broad shallow valleys. The soil is a deep, rich, sandy loam, with considerable humus on the lower levels of the tracts. Toward the outskirts of the groves, especially on higher ground, the soil grows poorer and drier, and the big trees grow scarcer, while yellow pine and incense cedar become more common. Frequent fires and extensive grazing in the Stanislaus grove have reduced, and in some parts destroyed, the naturally thick ground cover of underbrush and herbaceous plants. In the Calaveras grove, however, the protection from fire and the exclusion of grazing during the last thirty or forty years have preserved in this forest the most perfect ground cover of low woody and herbaceous plants (see Pl. CII). As a result, the top layers of deep humus and earth are moderately moist, even in the driest months; while 100 yards outside, where fires are frequent and the forest land is overgrazed, there is no humus and the soil is dry and dusty. The forest conditions of these two tracts are therefore markedly different. The Calaveras tract represents, through its long protection, probably the only bit of strictly virgin forest anywhere in the Sierra. The Stanislaus tract approaches nearest to these conditions of any other body of forest in the region examined. The vigorous undergrowth which persists in parts of this forest, even under the trying conditions of an open stock range, is due almost entirely to the small but continuous flow of water during the dry season. It is evident, therefore, that had this grove been rigidly protected the luxuriousness of its forest growth would have far surpassed that seen at present in the Calaveras grove.

The trunk of the big tree has an enormous swell at the ground. This swell is 2 to 8 feet greater than the diameter at 6 feet from the ground. The trunk above the swell is also rather strongly conical, often showing a decrease in diameter of from 6 to 12 inches or more in every 16 feet. The length of clear pole varies from 100 to 180 feet; occasionally two or three branches may be scattered over this length.

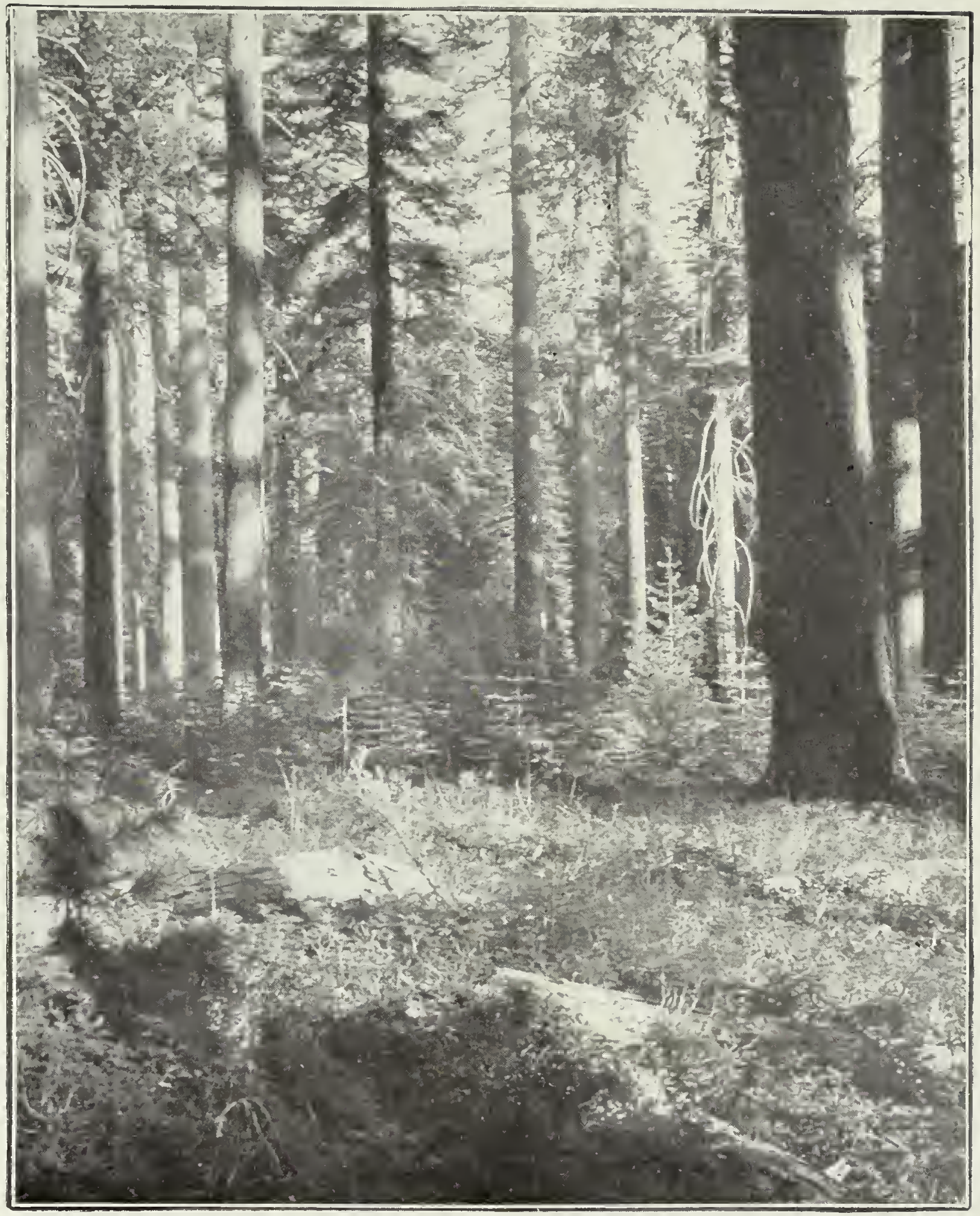
As might be expected, the Calaveras grove big trees are less damaged by fire or wind, or other agencies than those in the Stanislaus forest. Only a few of the former bear fire marks, which do not, however, disfigure the trees badly. The damage from fire occurred many years ago. The largest tree in the grove is dead, but still standing. The bark was stripped off in the early fifties to a height of about 116 feet, and sent to England for exhibition purposes. The peeled trunk appears to be perfectly sound throughout.

A greater number of the Stanislaus grove big trees bear fire marks than do those of the Calaveras grove. The damage is also greater and more conspicuous; in one or two trees the fire has hollowed out immense cavities. Moreover, considerable burning has taken place in recent years.

The following table of measurements shows the range of height and diameter growth for trees in the Calaveras grove, and will also serve to illustrate the dimensions of trees in the Stanislaus grove. The trees of the two groves are altogether quite similar in size and appearance.



A. CALIFORNIA BLACK OAK (QUERCUS CALIFORNICA (TORR.) COOPER).



B. BEST DEVELOPMENT AND MAXIMUM DENSITY OF A MIXED FOREST.

A. BAND OF SHEEP IN YELLOW-PINE FOREST, NEAR SOUTH FORK OF MOKELUMNE RIVER.

B. SHAKE-MAKER'S CABIN.

Table showing diameter and height of big trees in the Calaveras grove.

Tree No. —	Diameter 6 feet above ground.	Height.	Tree No. —	Diameter 6 feet above ground.	Height.	Tree No. —	Diameter 6 feet above ground.	Height.
	Feet.	*Feet.*		*Feet.*	*Feet.*		*Feet.*	*Feet.*
1	9.0	235	11	12.5	250	21	15.0	325
2	9.0	251	12	12.5	266	22	15.5	268
3	9.5	260	13	13.0	286	23	15.5	272
4	10.0	237	14	13.5	320	24	15.5	289
5	10.0	243	15	14.0	259	25	16.0	262
6	10.0	261	16	14.0	265	26	16.0	275
7	10.5	248	17	14.0	269	27	16.5	266
8	11.0	255	18	14.5	278	28	16.5	268
9	11.0	260	19	15.0	285	29	16.5	288
10	12.0	248	20	15.0	307	30	19.5	315

It is at present very difficult to determine the age of big trees in these groves. With the exception of a weather-beaten section of the tree cut down in the Calaveras grove in 1853, there is no available material on which to base age determinations. The diameter of the stump of this tree measured 27 feet inside the bark and the age of the tree is about 1,300 years. Mr. John Muir states that a tree of similar diameter cut down in the Kings River grove was 2,200 years old. He also mentions another tree of the same grove as being 4,000 years old, and probably older, as all the rings could not be clearly counted. Probably none of the Calaveras or Stanislaus grove trees are older than this, and most likely the majority are under 2,500.

The big tree is not being reproduced at all in the Calaveras grove, and at only two points in the Stanislaus forest. Here the young growth occurs in small, dense patches covering about one-fourth of an acre. The seedlings are from 2 inches to 4 feet high, and the saplings are from 10 to 30 feet high. They have sprung up in open places almost completely shaded by old big trees, sugar pines, and white firs. The soil has a deep humus and is constantly and thoroughly moist. A barrier of fallen timber has doubtless for a number of years prevented the large herds of cattle which roam this forest from trampling the younger seedlings to death. All the young trees are vigorous and growing rapidly.

The drier soil conditions of the Calaveras grove account for the lack of recent reproduction. Judging from the large amount of soil moisture attending reproduction in the Stanislaus grove, it is perfectly evident that the soil of the Calaveras grove is too dry to stimulate germination; otherwise, young trees would be found. The production of seed appears to be abundant, and 30 to 40 per cent of the seed examined was good. There has probably been no reproduction in this grove for at least forty or fifty years, for the smallest trees found are now 18 to 24 inches in diameter.

CALIFORNIA BLACK OAK.

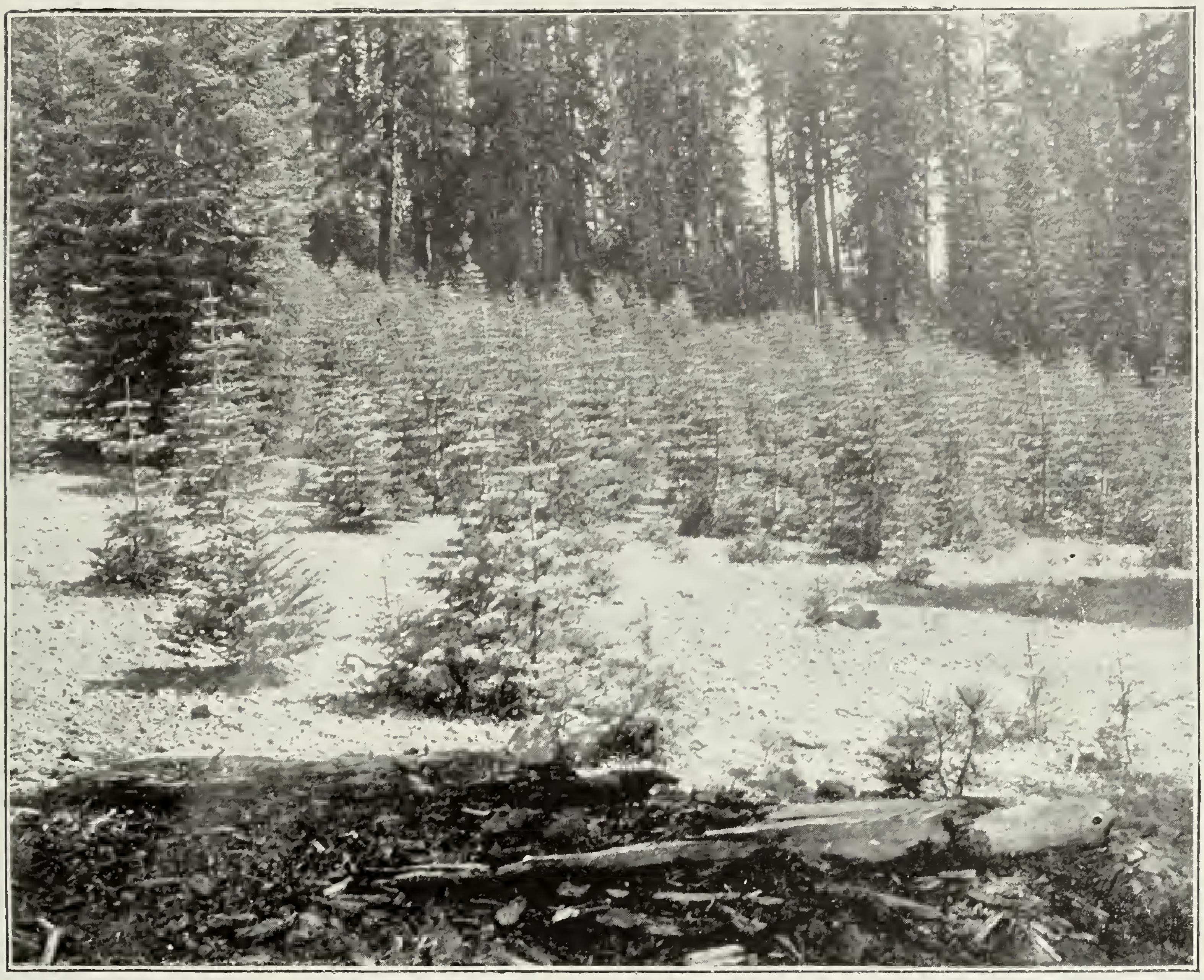
Of the remaining sixteen trees found in the middle timber belt, the California black oak is the only one deserving special notice. This is, however, entirely on account of its large size and frequent occurrence. Its poor form and inferior wood make it a tree of no economic value. It is more conspicuous as an associate of yellow pine and incense cedar than any of the other large trees. The altitudinal range is from 1,500 to 6,500 feet, while it occurs most commonly and of largest size between elevations of 3,500 and 4,500 feet. At the lower and higher elevations mentioned this oak is usually rare and of small size. In its middle range it forms 5 to 10 per cent of the total stand. In many localities, however, small areas may be found where this tree constitutes one-half or more of the forest growth. Such areas are frequent on dry, rocky benches of the southern and western slopes of river canyons, and also on the gravelly summits of the low mountains within the yellow-pine belt.

In its greatest abundance the California black oak occurs only in an open stand, and being of short stature its presence is lost sight of in general views of the prevailing coniferous growth. It is conspicuous only in a careful examination of the forest. The usual height is from 40 to 50 and exceptionally 70 feet. The diameter ranges from 1 to 2½ feet, while occasional old trees are 3 to 4 feet in diameter (see Pl. CIII). Large trees are 150 to 200 years old. The trunks are uniformly short and very crooked; the crowns are broad and composed of a few large sprawling limbs. The wood being brittle, the tops of the trees are frequently broken by winds, and as a result the trunks of the majority of old trees are hollow or decayed. Many of these are blown down or broken off.

The reproduction of this species is very persistent and abundant throughout its range. Frequent surface fires damage or kill the seedlings down to the ground, but rarely injure the strong deep roots, which sprout vigorously from year to year, until one shoot grows large enough to survive burning. The hard, thick bark of even young trees endures considerable scorching without damage to the tree.

Rare or Unimportant Trees.

The remaining trees of the middle timber belt are comparatively rare, being confined in their range either to the bottoms of canyons or to other similarly restricted localities. With few exceptions, they are of small size, and few are of economic value. Together, however,



A. REPRODUCTION OF CALIFORNIA RED FIR (ABIES MAGNIFICA MURR.).

Gravelly mountain summits, near headwaters of Blue Creek.

B. SUBALPINE LAKE AND MARSHY MEADOW.

they form a low protective forest cover, chiefly broadleaf in character, in localities where conifers are least abundant. Brief notes are given for the more conspicuous or otherwise notable species.

CANYON LIVE OAK.

The canyon live oak is the largest of these trees, and the most widely distributed. It is scattered through all canyons from 1,500 to 6,000 feet elevation, and occasionally ascends low mountain ridges and spreads over high, broad valleys. The largest trees occur between about 3,000 and 5,000 feet elevation. It is a low, broad-crowned tree with huge branches extending from a trunk 4 to 8 feet in length. The trunks are 1 foot to sometimes 4 feet in diameter.

OREGON MAPLE.

The Oregon maple is the next most widely distributed species, and the only one of its kind in the middle belt. It is mostly a low, very crooked tree, occurring sparingly near streams or in the bottoms of canyons, at elevations between 2,000 and 4,500 feet. Occasionally it forms the principal tree growth for short distances along small streams. The short crooked trunks are 8 to 20 inches in diameter.

PACIFIC DOGWOOD.

Pacific dogwood is a small tree, sparsely but generally distributed between elevations of 3,000 and 5,000 feet. It is partial to deep shade and moist soils in the vicinity of small streams and coves. The common size is 10 to 20 feet high and 2 to 8 inches in diameter.

BLACK COTTONWOOD.

Black cottonwood grows along streams, or less commonly near the shores of large lakes. It appears rather abundantly at several points in the bottoms of the larger river canyons. The growth is rarely continuous for any considerable distance, but more often groups or small patches of trees are widely scattered. Its range in altitude is from 3,000 to 6,500 feet. Where most abundant the trees form dense patches down to the water's edge, to the exclusion of other trees. Here the trunks are straight and clear of branches for 15 to 20 feet. The largest trees are 25 to 35 feet high and 10 to 24 inches in diameter.

WHITE ALDER.

White alder is nowhere abundant, but frequent on streams between elevations of 2,000 and 5,000 feet. In a few instances it descends on small streams to 1,000 feet. It usually grows close to the water and in a more or less continuous fringe for a considerable distance. It is especially at home in a wet soil, and occasionally quarter-acre patches of pure growth occur in wet boggy creek bottoms. The trees are 25 to 30 feet high and 6 to 20 inches in diameter. The trunks are short, straight, and much branched, somewhat resembling a beech.

MADROÑA.

The main range of the madroña lies in the coast region of California and northward, and so far as known to me this tree has never been reported from any locality in California as far east as the Sierras. The madroña occurs rather abundantly in a few localities in the middle timber belt at elevations of from about 2,500 to 4,000 feet. It occurs in the moist soil of shady coves, on small streams, or in dry, clayey and gravelly soils of low slopes, here mingled with yellow pine. Almost pure growths of several acres' extent occur on low slopes and in bottoms. It was found in greatest abundance on the headwaters of Sutter, Pioneer, Mill, and Jesus Maria creeks. It was found also, but less abundantly, on Empire Creek, between Garden Valley and Georgetown, and on Otter Creek (tributary to Middle Fork of American River). Large trees are crooked and scraggy, ranging in height from 30 to 40 feet, and in diameter from 12 to 20 inches. It forms a dense shade in pure growth, and appears to spread and hold its own in the densest thickets of yellow pine. It sprouts vigorously from stumps when cut, and also from the roots when the trees are burned to the ground.

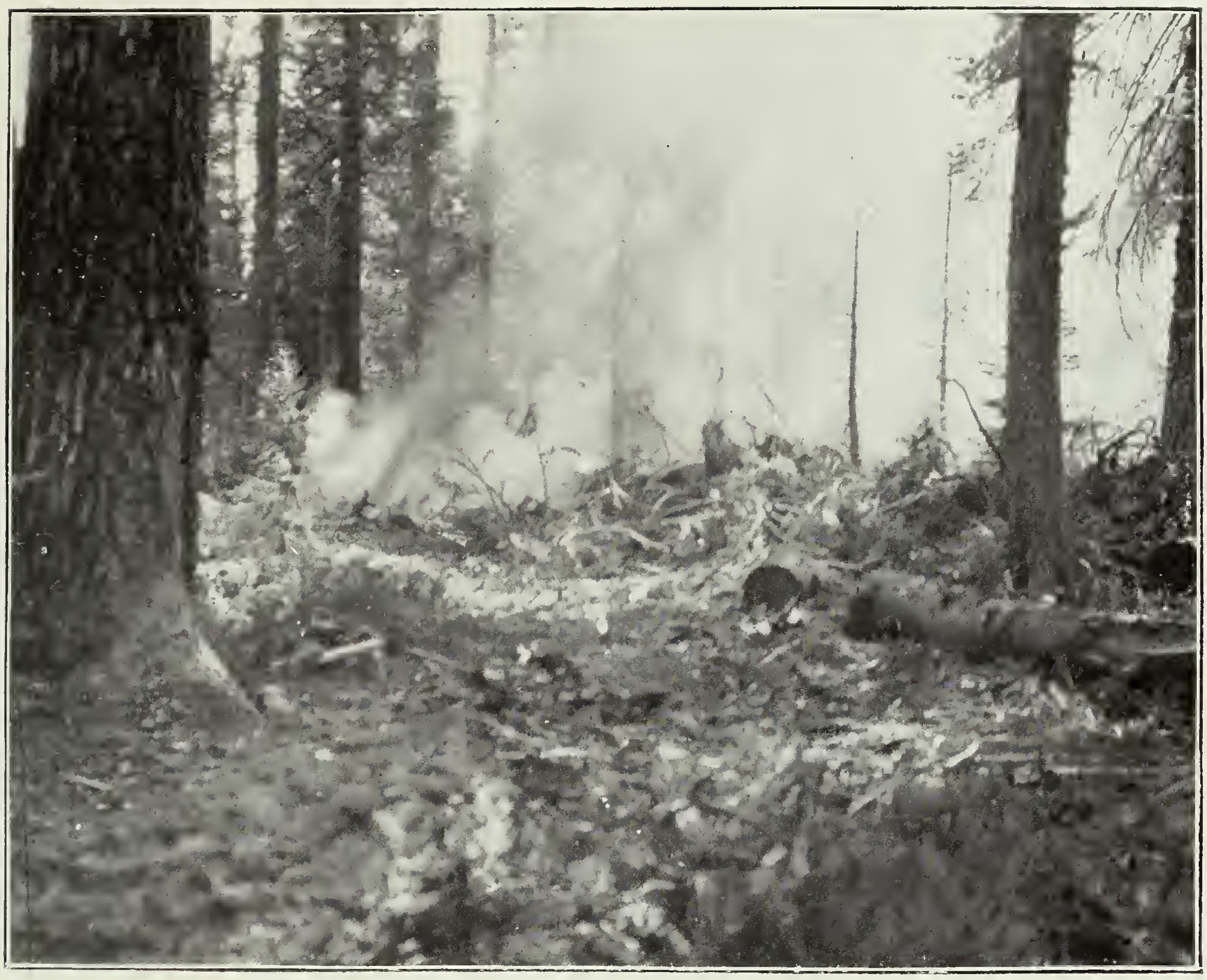
TAN-BARK OAK.

The range of this tree appears to be limited. Although occurring rather abundantly where discovered, it was found in only a few localities at altitudes ranging from 3,000 to 5,000 feet. These are on the west slope of Tunnel Hill, on the headwaters of Otter Creek, on Pilot Creek, in the vicinity of Deep Canyon and Mutton Canyon; also in Big Iowa Canyon (tributary to South Fork of American River). It grows in dry sandy and gravelly soils on exposed slopes, and frequently in deep, shady coves and canyons. Rarely more than two or three trees occur together. It is a low, much-branched tree, the trunk dividing near the ground into large branches. The height is under 30 feet, and the diameter is from 6 to 18 inches.

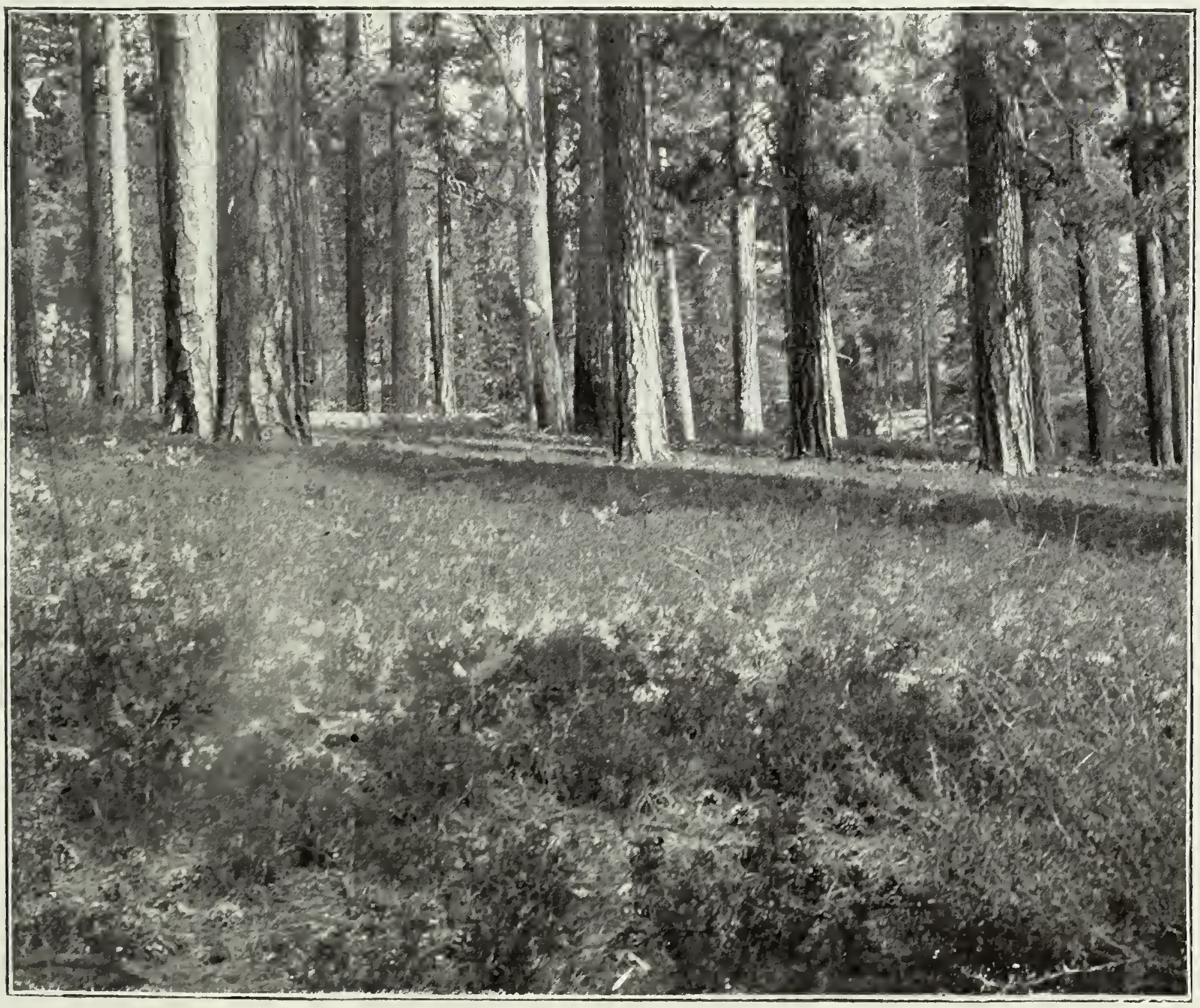
The low, bushy variety of this species (*Q. densiflora* var. *echinoides*) forms thickets on the north slope of Rubicon River Canyon at 4,000 to 4,500 feet elevation.

CALIFORNIA SCRUB OAK.

The California scrub oak completes the list of oaks found in this belt. It is a slender, shrubby species, 6 to 15 feet high, forming small thickets near the bottoms of canyons. It was seen at elevations of 2,500 to 3,000 feet on the headwaters of Esperanza Creek (tributary



A. FOREST FIRE SET BY LUMBERMEN TO BURN OUT A "JAM" OF TOPS.



B. INTERIOR OF YELLOW-PINE FOREST ON SANDY BENCH LAND.

to North Fork of Calaveras River) and on San Antonio and Indian Creek (tributaries to South Fork of Calaveras River).

SHORT-FLOWER MAHOGANY.

The short-flower mahogany is a rare shrubby tree seen only on the south slope of Indian Creek Canyon, near the headwaters, at 3,000 feet elevation.

COFFEE BERRY.

The coffee berry (*Cascara sagrada*) is a rather common shrub, 4 to 6 feet high, and occasionally occurs as a slender tree 10 to 20 feet high on dry, gravelly, and rocky slopes and summits, at elevations from 1,500 to 6,000 feet. It is most abundant between 2,500 and 4,000 feet elevation, and is a frequent associate of the shrubby manzanita.

WESTERN CHOKECHERRY.

The western chokecherry is a rare, slender tree seen in the canyon of the South Fork of American River at an elevation of 4,000 feet and also on the north slope of Mokelumne River at 2.500 feet elevation.

PACIFIC PLUM.

The Pacific plum is also a rare tree of shrubby habit, forming small thickets on dry slopes of canyons at elevations of 3,000 to 4,000 feet. It was seen on the headwaters of Camp Creek (tributary of North Fork of Cosumnes River) and at the head of Pioneer Creek (tributary of Sutter Creek).

CALIFORNIA TORREYA.

This species is exceedingly rare, if it is not the rarest in the region. Only 16 trees were seen. These were in the canyons of the following streams: Empire Creek (tributary of South Fork of American River) at 2,500 feet elevation; north slope of South Fork of Mokelumne River at 2,000 to 2,500 feet elevation; San Antonio Creek (tributary of South Fork of Calaveras River) at 2,000 feet elevation, and on South Fork of Webber Creek at 3,000 feet elevation. They are small, straight trees, 10 to 30 feet high, with branches down to the ground, and thrive in the densest shade of yellow pine, cedar, and red fir. A few seedlings were found near one group of trees only. The reproduction of this species is apparently very limited, owing to the fact that being diœcious only a part of the trees bear fruit; and this, too, is produced sparingly.

PACIFIC YEW.

The Pacific yew is also comparatively rare and isolated. It occurs in the deepest shade of red fir, white fir, and incense cedar, in moist soil along small streams, and in ravines and narrow coves. Only a few trees occur in each locality, and these are commonly low and widely branched to the ground. The height is from 10 to 20 feet and the diameter is from 6 to 10 inches. Moderate reproduction was seen near groups of these trees. The localities in which this species was found are as follows: Vicinity of Mutton Canyon and Deep Canyon (branches of Pilot Creek, a tributary of Rubicon River) at 4,000 feet elevation; Big Iowa Canyon (tributary of South Fork of American River) at 3,000 feet; headwaters of Sly Park Creek (tributary of North Fork of Cosumnes River) and North Fork of Webber Creek, at 4,000 feet; at 2,500 to 3,000 feet on the headwaters of Cedar Creek (tributary same river); at 3,500 feet on Clear Creek (tributary of Webber Creek); headwaters of Mill Creek (tributary of North Fork of Mokelumne River) at 3,500 to 4,000 feet elevation.

Shrubs.

Besides the trees of this timber belt, there are several large shrubs, of which the manzanita (*Arctostaphylos pungens*) is the most conspicuous. It is widely distributed on all dry gravelly slopes at elevations of from 1,500 to 6,000 feet. It grows abundantly in open places among yellow pines, and quickly takes possession of exposed slopes wherever patches of forest have been cut or burned off. Here its stiff harsh stems form almost impenetrable thickets from 6 to 10 feet high. Surface fires repeatedly kill the growth down to the ground, but the roots sprout vigorously and continue to maintain a strong protective cover, which is important on steep slopes. In localities where the ground is not too constantly burned over this chaparral does not exclude the final but slow recovery of the land by conifers.

UPPER BELT.

Abundant and Important Trees.

The major part of this belt is made up of three conifers—the lodgepole pine, Jeffrey pine, and California red fir. The white fir is more or less frequent at the lower limit of the belt, but even here must be regarded as a straggler from below. The other conifers and broadleaf trees of the belt form no considerable part of the forests. Altogether the commercial importance of this forest is small, except at the lower limit, where most of the large timber is found and where also this timber is most easily accessible.

LODGEPOLE PINE.

This pine is widely distributed between elevations of 6,000 and 9,300 feet, while the area of greatest abundance lies between 6,000 and 8,500 feet. A few trees, however, were discovered at elevations of 3,500, 4,000, and 5,000 feet. These stations are far distant and in no way connected with the wider range of the species, and must, therefore, be considered mere outposts. The lodgepole pine occurs most

A. SOUTH FORK OF AMERICAN RIVER, NEAR BULLION BEND.

B. CANYON OF SOUTH FORK OF AMERICAN RIVER.

abundantly in pure growth on the margins of mountain meadows. On higher ground it is associated more or less with Jeffrey pine, California red fir, western white pine, and occasionally with black hemlock, here forming 50 per cent of the stand. The forests of pure growth are rather dense (100–150 trees to the acre), but in mixture on higher, rocky, broken ground the stand is open and often scattered (40 to 50 trees per acre). This tree shows a remarkable adaptation to widely different soil conditions and site. It thrives best in the meadow bottoms, but spreads persistently over low rocky ridges and stretches of high granite plateaus, establishing itself everywhere in crevices and pockets. The trunk form is poor, though moderately cylindrical, and is altogether much inferior to that produced in the Rocky Mountain range of this species. Except in patches of the densest stand, the trunks bear large limbs down to the ground. The height is from 30 to 80 feet, with diameters ranging from 11 to 39 inches; diameters from 11 to 24 inches are most common. On the high, wind-swept sites at the upper limits of distribution the trunk becomes very short, in fact the form is reduced to a sprawling shrub under 2 feet in height. The age of the largest trees is from 100 to 150 years.

The reproduction of lodgepole pine is everywhere abundant and most persistent. Dense thickets of young trees and seedlings are common wherever there is soil, and are always present in crevices and pockets where the tree occurs on granite. Patches of fire-killed timber are replaced in a few years by reseeding from cones on the dead trees, the cones being rarely destroyed by surface fires. A notable difference between the Sierra and Rocky Mountain form of this tree is that cones of the former usually open and shed their seed during the same year they mature. Mature cones of the Rocky Mountain lodgepole pine are likely to remain closed for several seasons before opening.

CALIFORNIA RED FIR.

The California red fir is one of the three conspicuous trees in the upper timber belt, and is also the fir most commonly met with. Although generally distributed, the bulk of this timber occurs in forests more or less separate from those of lodgepole and Jeffrey pine. The altitudinal range is between 6,000 and 8,500 feet, and the prevailing growth lies between 6,500 and 7,500 feet. Its occurrence at levels between 5,000 and 6,000 feet is straggling. Forests of pure growth are frequent on the soil-covered lava-rock benches on the eastern, southern, and western slopes of the larger mountain peaks and ranges. Interspersed with such areas are those with a mixed forest of lodgepole pine, Jeffrey pine, silver pine, and black hemlock, in which the California red fir forms 40 to 50 per cent of the stand. The forests of pure growth are usually of considerable extent and uniformly so dense as to exclude all undershrubs. In this respect these fir forests are exceptional for the entire territory, as no other timber tree produces so dense a stand. The mixed growths are more open.

The trunk form of this species at the lower levels of its range is cylindrical, and the shafts are remarkably straight and clear of branches for 40 to 60 feet or more. At the middle and upper levels of distribution the trunks are very conical, short, and invariably strongly curved at the base. This curve in the trunk is traceable, however, to the annual bending of young seedlings to the ground by heavy falls of snow. After the snow is gone, the young trees are partially straightened up by each season's upward growth, but the wide curve in the stem is retained and becomes a marked feature in the mature trunk. The height of this fir is from 80 to 175 feet, with diameters ranging from 12 to 60 inches. In the area of greatest abundance the common sizes are 100 to 140 feet in height and 24 to 40 inches in diameter. The largest dimensions are attained by scattered trees at the lowest limit of distribution, while the smallest trees are found at the upper limit. The age of mature trees is from 250 to 300 years.

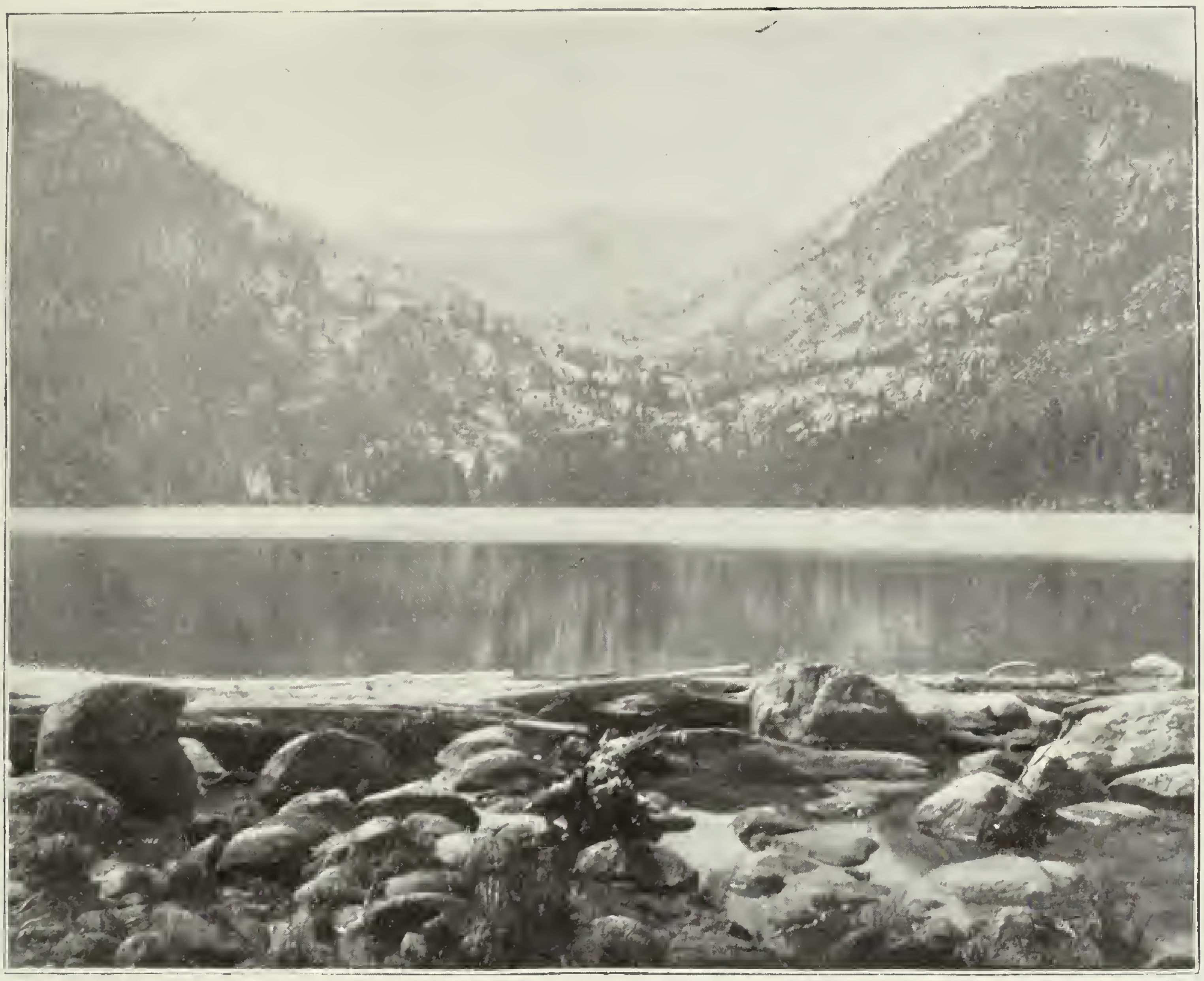
The reproduction of this fir is exceedingly abundant. The smallest openings made in high fir forests is promptly filled by seedlings. The shade endurance of seedlings under such conditions is very great. Frequently they remain suppressed for 10 to 20 years and are no more than 2 or 3 feet high. The remarkable capacity of California red fir for re-covering large denuded areas is seen where fire and excessive grazing have left the gravelly soil bare and dusty. Here, if by accident those spots are undisturbed for several years, this fir springs up in the closest possible stand, and the young trees grow rapidly, reaching a height of 8 to 10 feet in five to seven years. Their thrifty, vigorous appearance is striking (see Pl. XCV, *B*). Comparatively speaking, this fir is reproduced more plentifully than the white fir. The reasons for this appear to be three—greater seed production, more soil moisture, which alone insures full germination of the seed, and less destruction by fire. There is one other advantage which this fir has over the white fir. A smaller percentage of California red-fir seed is eaten by rodents than of white-fir seed, a fact which is accounted for because these animals are far more abundant in the yellow-pine belt, where the white fir abounds, than in the higher range of the California red fir.

JEFFREY PINE.

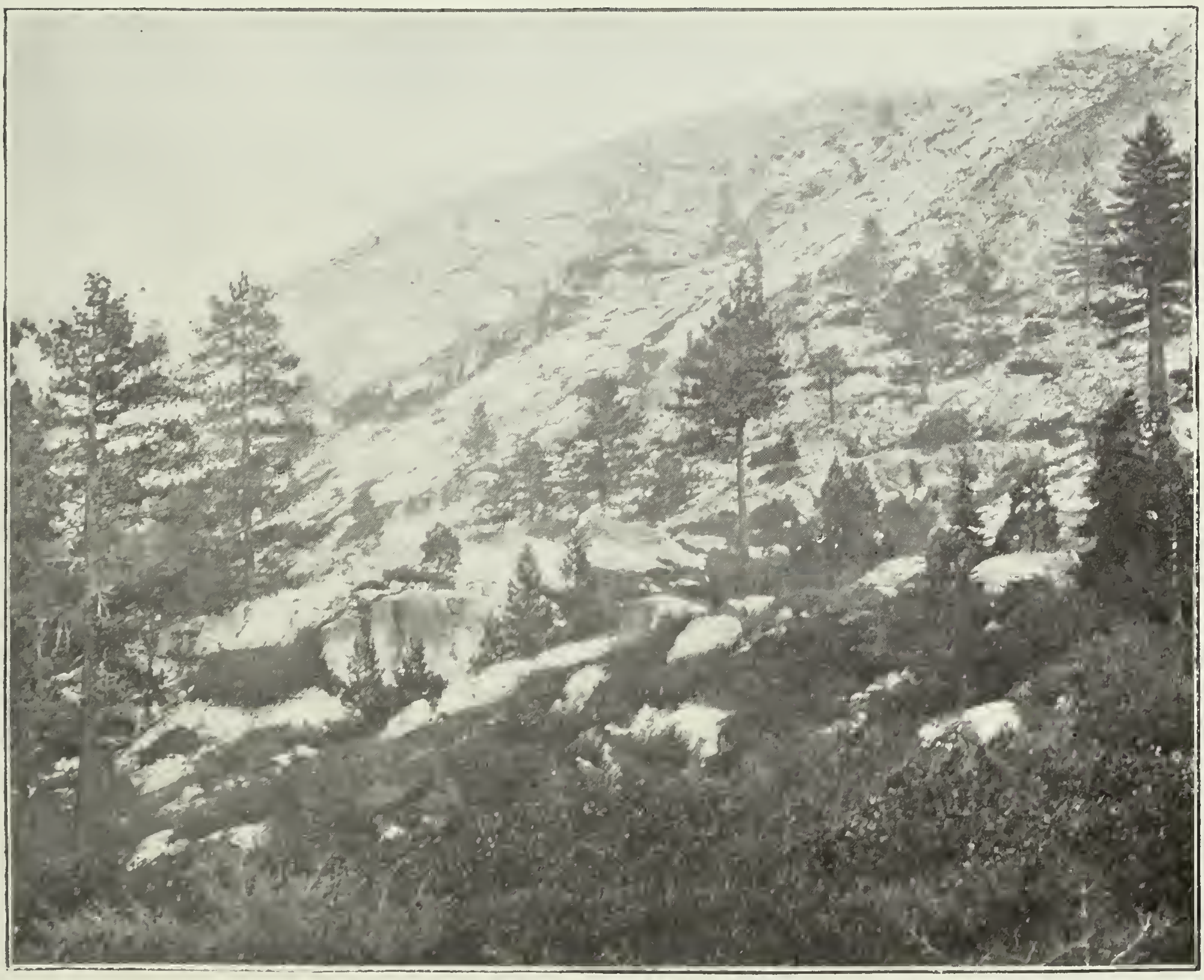
This pine has been fully discussed as a tree of limited occurrence in the middle timber belt, where the small production of useful timber gives the tree its only commercial importance.

WHITE FIR.

The white fir, which is fully described as a principal species of the middle or yellow-pine timber belt, is mentioned in the present connec-



A. CASCADE LAKE, LOOKING SOUTHWEST FROM NORTH END OF LAKE.



B. WEST SLOPE OF RUBICON RIVER CANYON.

tion only as a species irregular in its extension into the upper timber belt. It occurs here very sparingly and is usually associated only with California red fir. There appears to be great irregularity in the extension of this fir into the upper belt, the extension consisting in isolated trees or small groups.

Rare or Unimportant Trees.

WESTERN WHITE PINE.

Western white pine is rather rare but widely distributed between 6,500 and 9,400 feet elevation, being most frequent between 7,000 and 8,500 feet. It appears as scattered individuals, or at most several trees together, associated with California red fir and black hemlock, or less frequently with lodgepole pine. In rare instances small areas of mixed forest may contain 5 to 15 per cent. On very rocky exposed high slopes it is sometimes conspicuous in being about the only straggling tree. The trees are gnarled and twisted in such locations, becoming greatly stunted at the extreme upper limit of distribution. The trees found in the mixed forests of lower levels are generally of good timber form, the trunks being straight, cylindrical, and clear of branches for 30 or 40 feet. The height of such trees is from 100 to 140 feet and the diameter is from 15 to 40 inches. Isolated trees on high exposed slopes are rarely over 50 feet in height, but frequently 30 to 50 inches in diameter, the limbs on these trees extending nearly to the ground. Mature trees are 160 to 225 years old.

Very little reproduction of the species was observed, although both the forest grown and other trees bear seed plentifully. Only a few scattered seedlings, from 6 inches to 3 feet high, are found near trees in the mixed forests, and still more rarely are seedlings found about trees in the open. The sparse reproduction of this pine is in marked contrast with that of the prolific lodgepole and Jeffrey pines, and indicates the much smaller capacity of this tree to multiply even under apparently favorable conditions.

But for the very limited supply of this timber, its excellent quality in mixed forests would give the species great commercial importance as a timber tree.

BLACK HEMLOCK.

Black hemlock is a strictly subalpine tree, confined chiefly to northern slopes at elevations between 6,900 and 9,400 feet. It is generally distributed within these limits and associated often with lodgepole pine only, or with western white pine, lodgepole pine, and California red fir; while in its highest range it occurs in small patches by itself, interspersed with those of white-bark pine. The mixed growths of lower levels are usually low, rather thin forests, entirely protective in character, largely on bare, broken lava rock or granite. Mixed with lodgepole pine it grows also on the mucky borders of subalpine meadows and lakes (see Pl. CV, *B*). Black hemlock is most abundant between 7,000 and 8,500 feet elevation. Within this area the hemlock sometimes forms from 10 to 25 per cent of the total stand. At the highest and lowest limits of distribution the occurrence of this species is irregular and at wide intervals. The common trunk form is rather strongly conical and the stem bears branches quite to the ground. A few of the larger trees in protected gulches or on benches are fairly cylindrical, and the trunks are clear of branches for 20 feet to 30 feet. The trunks are never quite straight, being slightly curved. The height is from 25 to 90 feet, the prevailing height being 30 to 50 feet. Diameter measurements are from 12 to 32 inches, but the latter dimension is rather rare. The age of low timber in open forests on rocky sites is from 80 to 150 years, and that of larger trees in denser growth in protected localities is from 160 to 190 years. The largest trees of the open, exposed forests are often uprooted by high winds, a fact which may account for the general absence of old trees in this type of forest, while large trees in protected localities are less commonly destroyed by storms.

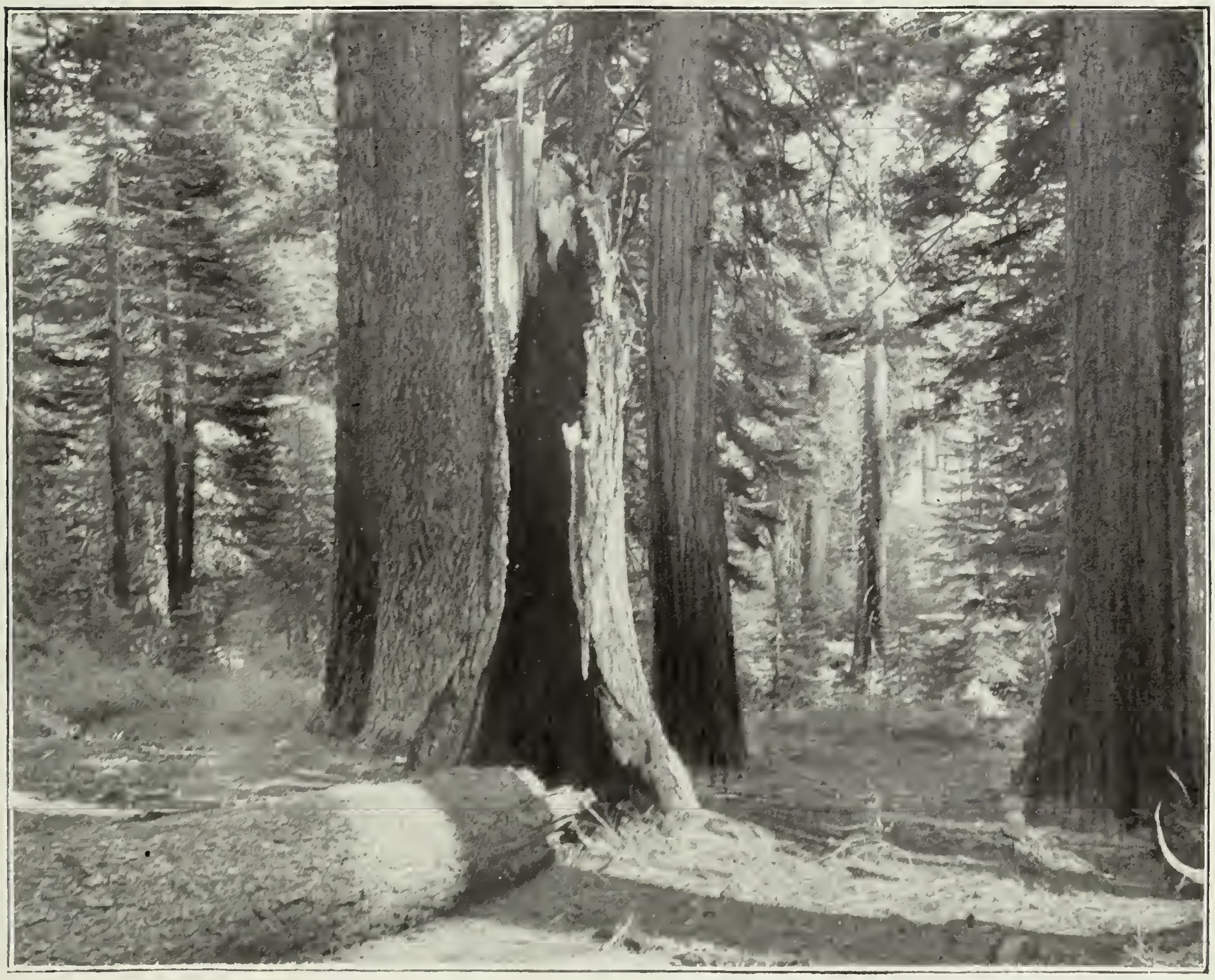
Black hemlock is reproduced plentifully throughout the major part of its distribution, the extreme upper limits of range being the exception to this, here showing only occasional reproduction. Numerous small seedlings and patches of young trees 3 to 10 feet high are present everywhere among the older trees. The old and even half-grown trees bear large crops of cones which yield an abundance of seed, and the high range of the tree on northern slopes usually insures to the fallen seed more prolonged moisture conditions than are available to species prevailing on the dryer southern, eastern, and western slopes.

The black hemlock has no commercial value, but is an important concomitant of protective forests on and near the extreme headwaters of the larger streams or their tributaries.

WESTERN JUNIPER.

This is a tree of high altitudes and of exposed situations. It is nowhere abundant, but is frequent as a scattered tree on bare granite-rock slopes and low summits between 7,000 and 8,500 feet elevation. On some of the mountain ranges it is more common on southern than on other slopes, yet elsewhere it is found on eastern and western exposures also. The western juniper never forms a close stand. Single trees, or clumps of two or three trees very close together, occur at rather wide intervals, at most not averaging more than three trees to the acre (see Pls. XCVI, *B*, and XCVII, *B*). Its principal associate is the similarly scattered Jeffrey pine. In the more exposed situations the trees are low and of disproportionately large diameter. The tops are frequently broken by storms, but the trees are so strongly rooted in the crevices of rock that few are ever uprooted. Occasional protected gulches have much taller and better proportioned trees. The

A. LITTLE SOUTH GERLÉ CREEK AT WEST END OF LOON LAKE.



B. SUGAR PINE 4 FEET IN DIAMETER FELLED BY PERSISTENT BURNING.

height growth is from 20 to 30 feet, and in rare instances 35 to 40 feet, with diameters from 2 to 4 feet. The trunks are very irregular in form, usually having prominent broad ridges and being widely buttressed at the base. Stout branches are borne nearly down to the ground, leaving little or no clear trunk.

The reproduction of this juniper is sparing, but young trees and seedlings are nearly always to be found in numbers quite proportionate to the stand of mature trees. There is evidence in this and in the profusion of berries borne that this species holds its own. It is a tree of no economic importance, however, and because of its scattered growth contributes very little to the protective forest cover of the high mountains.

WHITE-BARK PINE.

This pine has the most limited range in altitude of any conifer in the upper timber belt, but reaches a higher elevation than any other tree within these limits. It grows among broken bare rocks and in beds of disintegrated granite at elevations between 8,000 and 9,500 feet, forming small patches of stunted and storm-beaten trees with which, except at the upper levels, are interspersed groups and single trees of black hemlock, Western white pine and lodgepole pine. At the upper limits of its distribution the white-bark pine is the only tree and is the one which fixes the timber line for this belt. White-bark pine grows on eastern, southern, and western slopes only, showing no tendency to establish itself on contiguous northern slopes, even at points where descent to such locations would seem natural.

The largest trees occur at the lowest levels of distribution, while successively smaller trees are met as higher levels are reached. The form of this species found at and near timber line is represented by a sprawling mat of branches lying flat on the rocks; the branches often grow to great length from a trunk less than a foot high. Trees of greater height can not withstand the terrific winds which sweep over these high, bare slopes and summits.

The trunks of this pine are, for the most part, crooked and twisted or gnarled. Occasional trees on the lower levels are straight, but these still show in their conical trunks the effects of exposure to heavy winds. The usual height of the largest trees is from 8 to 20 feet, with diameters from 14 to 24 inches. While these short, sturdy trees generally withstand the fierce winds and the falling and sliding of tons of snow and ice, many trunks are uprooted or torn asunder.

The reproduction of white-bark pine is rather scanty. A few stunted seedlings and young trees can be found near the patches of old trees; but more often seedlings take root under the low protecting branches of the old trees. Those beyond this shelter are so constantly and violently swayed by wind that many of the stems are gradually ground off by rubbing against sharp particles of rock. It is evidept from this difficulty in spreading, that the existing patches of this pine have been established after a hard struggle. Most of the reproduction being within these groups, the latter long remain narrowly circumscribed.

OTHER SPECIES.

The remaining trees of the upper belt are so insignificant in size as to deserve only passing notice. All are practically shrubs, forming low, tangled thickets along small streams on the borders of moist meadows, or on the lower edges of timber belts occupying steep slopes. In this they are useful adjuncts to the general protective forest cover of high altitudes.

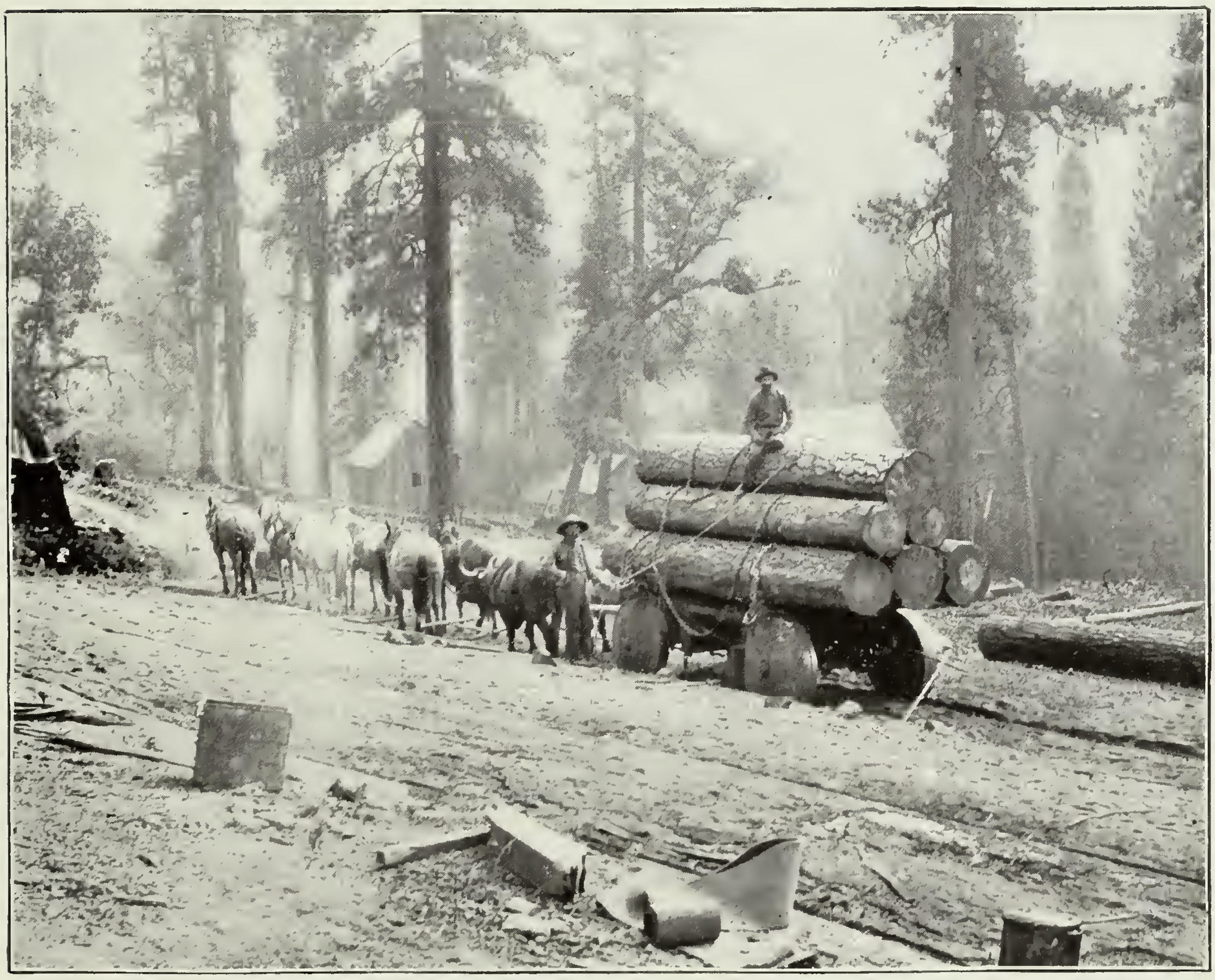
The smallest and the least abundant of these species is the dwarf maple found at altitudes between 5,000 and 7,500 feet, and mainly between 6,500 and 7,500 feet. Its slender stems are 2 to 10 feet high, and almost prostrate from the weight of heavy snows. The aspen is rather widely distributed at elevations between 6,500 and 8,500 feet, only occasional patches occur at 5,000 feet elevation. The small stems are rarely over 10 or 15 feet in height, and in the majority of instances the lower part of the trunk is greatly twisted or coiled and nearly prostrate. The bitter cherry forms dense sprawling thickets in localities similar to those of the aspen, and is fairly frequent throughout the same range. The bent and semiprostrate stems are 6 to 12 feet high and 2 to 6 inches in diameter. The paper-leaf alder is also a thicket-forming species confined to the upper courses of small streams, boggy places, spring heads, and the moist, mucky borders of meadows. It occurs at 6,000 feet elevation, but is abundant only between 7,000 and 8,000 feet.

Shrubs.

Besides the small trees just mentioned, there are several shrubs which are conspicuous in forming a low thick chaparral cover on rocky and gravelly summits and slopes between 6,500 and 8,000 feet elevation. This cover is of considerable importance as a ground protection, and where abundant prevents the rapid descent of water on steep slopes. It is most abundant among the open and scattered growth of Jeffrey pine, lodgepole pine, and juniper, and with these trees constitutes the sole protection of the upper watersheds (see Pl. XCVI, *B*). Large areas of this low cover are frequently killed to the ground by fire, but the roots are almost never injured, so that, if the burning does not recur within two or three seasons, the cover is replaced by a crop of new shoots. It is evident in certain parts of these brush-covered areas, that the existence of the shrubs, the roots of which break up the softer rocks, finally make it easier for timber trees to become established than would otherwise be possible.

The most important of these shrubs is the "deer brush" (*Ceanothus*

A. A GOLD MINER AND HIS CABIN; SETTLED IN 1849.



B. COMMON METHOD OF HAULING YELLOW-PINE LOGS TO SAWMILL.

prostratus Benth.), and a green-leafed manzanita (*Arctostaphylos*), common at the lower levels, and Palmer oak (*Quercus vacciniifolia* Kell.) and chinquapin (*Castanopsis chrysophylla minor* de C.), abundant at the higher elevations.

RECAPITULATION.

Table showing the altitudinal range of principal trees in the lower, middle, and upper timber belts.

Species.	General range.	Area of greatest abundance.
LOWER BELT.	*Feet.*	*Feet.*
Gray pine	500 to 3,000	1,000 to 2,000
California rock oak	300 to 1,500	500 to 1,000
MIDDLE BELT.		
Yellow pine	2,000 to 6,000	3,000 to 5,000
Incense cedar	2,000 to 7,000	3,500 to 5,000
Sugar pine	2,000 to 7,000	3,000 to 5,000
White fir	3,800 to 7,500	4,000 to 5,000
Jeffrey pine	5,000 to 8,500	6,500 to 8,500
Red fir	2,000 to 5,500	3,500 to 5,000
Big tree	4,600 to 5,000	
Calfornia black oak	1,500 to 6,500	3,500 to 4,500
Canyon live oak	1,500 to 6,000	3,000 to 5,000
Oregon maple	2,000 to 4,500	
Pacific dogwood	3,000 to 5,000	
Black cottonwood	3,000 to 6,500	
White alder	2,000 to 5,000	
Madroña	2,500 to 4,000	
Tan-bark oak	3,000 to 5,000	4,000 to 4,500
Short-flower mahogany	3,000	
Coffee berry	1,500 to 6,000	2,500 to 4,000
Western chokecherry	2,500 to 4,000	
Pacific plum	3,000 to 4,000	
Pacific yew	2,500 to 4,000	
California torreya	2,000 to 3,000	
UPPER BELT.		
Lodgepole pine	6,000 to 9,300	6,000 to 8,500
California red fir	6,000 to 8,500	6,500 to 7,500
Western white pine	6,500 to 9,400	7,000 to 8,500
Black hemlock	6,900 to 9,400	7,000 to 8,500
Western juniper	7,000 to 8,500	
White-bark pine	8,000 to 9,500	
Aspen	6,000 to 8,500	

USES AND MARKET PRICES OF TIMBER.

The timber trees of greatest commercial value in this region are the yellow pine, Jeffery pine, sugar pine, white fir, red fir, and incense cedar. These supply nearly all of the sawed timber and all of the round and rived material used. The less important useful trees are the gray pine, live oak, California black oak, lodgepole pine, and California red fir. Together with several of the above more valuable species, these timber trees supply the fuel, fencing material, and round logs used for buildings.

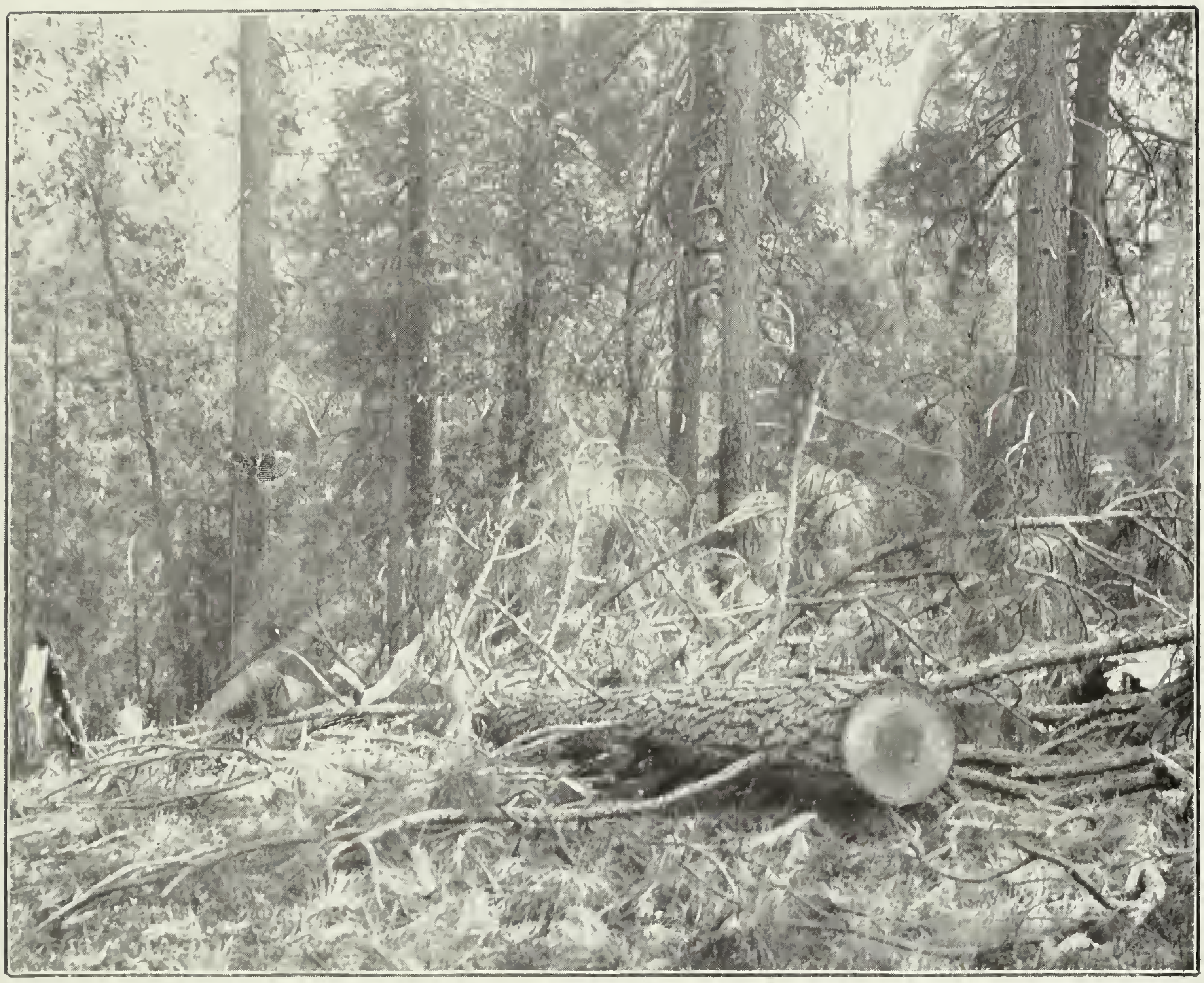
LUMBER.

The major part of all sawed lumber is cut from yellow pine (including the small amount of available Jeffrey pine). This is supplemented to a considerable extent by sugar pine, white fir, and red fir. A large proportion of the lumber sawed consists of inch boards and planking, and to a less extent of large-dimension square timber. High percentages of the best grades of clear stock are produced by all these trees. The sugar and yellow pines furnish the greatest quantities of clear lumber and are used most widely for construction. The excellent quality of yellow pine fits it for the finest interior finish, while its strength and durability make it applicable for general construction.

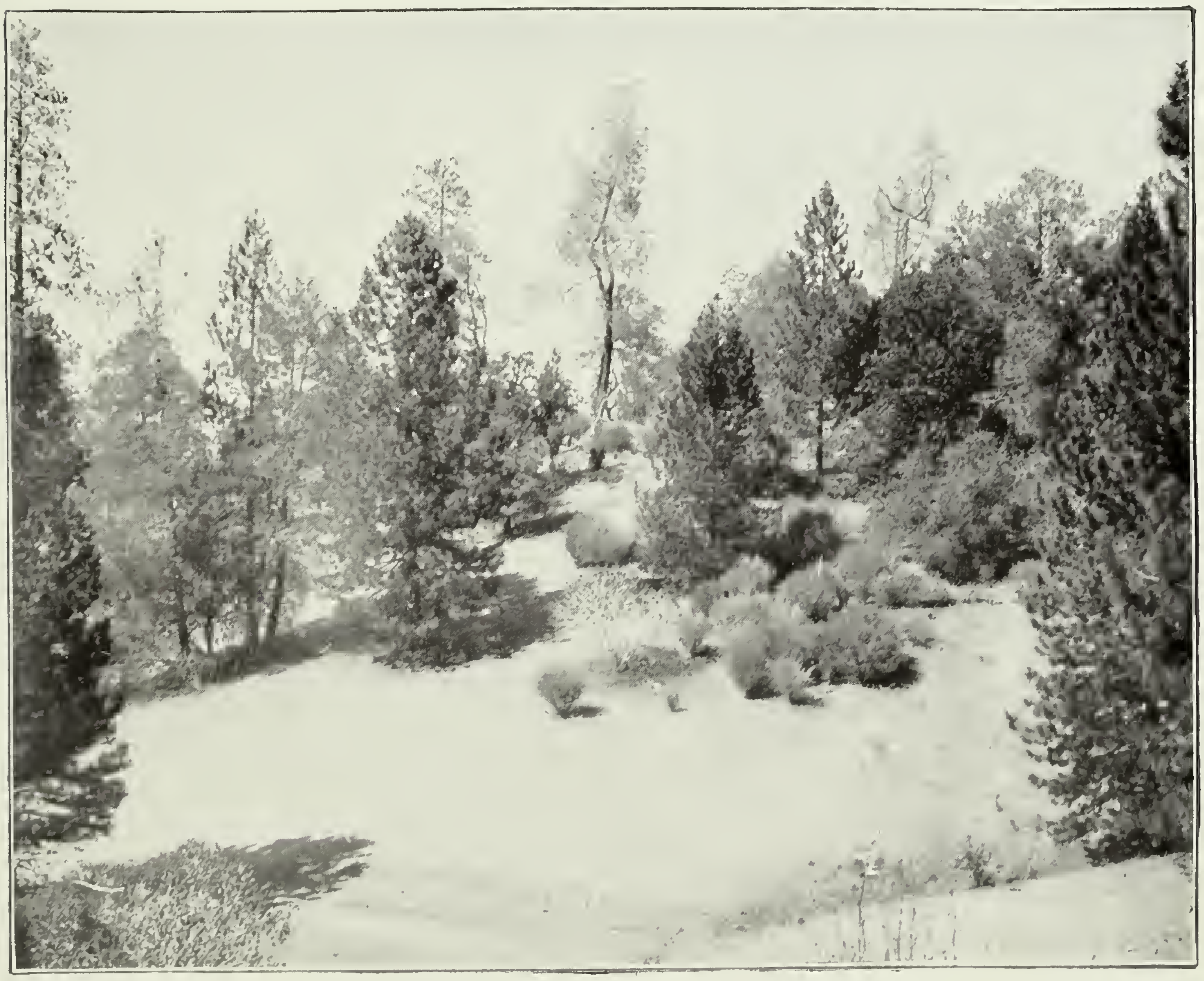
All of the sawed lumber derived from the forests of this territory is consumed here, principally by settlers in the mining and agricultural districts, a very small amount being used in the higher wooded regions. This local consumption prevails because without railroad facilities the lumber can not be placed on markets outside this region at prices low enough to compete with larger lumber manufacturers operating in territory served by railroads. The chief uses made of sawed lumber is for general house building in settlements, and also for construction at gold-mining plants, where, with other lumber, considerable large square timber is consumed. Very little round timber is used at the present time for houses and other buildings, except for summer cabins in the high mountains.

All lumber is hauled by wagon from mills to the various local markets. The length of the haul is from 10 to 25 miles, and the average cost of such transportation is about $5 per 1,000 feet. The price for second-class yellow pine, sugar pine, white fir and red fir lumber at the mills is from $9 to $10 per 1,000 feet, while the price for first-class or clear lumber hauled to the towns and mining camps is from $16 to $23, and dressed clear lumber is worth from $25 to $30 per 1,000 feet.

Sawed incense-cedar telephone and telegraph poles are used to a limited extent, and are the most durable poles available in the region. Apparently the diseased condition common in incense-cedar timber (see Pl. CXIII, *A*) does not unfit the wood for such purposes, as badly affected samples were constantly seen doing good service.



A. WASTE IN LUMBERING.



B. LOWER LIMIT OF YELLOW-PINE BELT.

STUDDING AND LAGGING TIMBER.

In addition to sawed timber used in mining operations, large quantities of round studding and rived lagging are consumed in deep shaft mining. These materials are derived almost entirely from yellow pine. Studding, which is used for large props, is cut from comparatively young pine—50 to 125 years old. The size of studding is 10 to 20 inches in diameter and from 16 to 18 feet in length (see Pl. CXIII, *B*). These logs are cut, peeled, skidded, and in order to lighten them are left to dry out for a time before hauling. The first cost of studding is about 50 cents per stick; hauled to the mines (distant 8 to 20 miles) it brings from $1 to $2 per stick. The large quantities of this timber used and the difficulty of hauling such heavy material in any but small amounts appears to keep up a lively demand.

Lagging timber, a small split or rived prop used extensively in surfacing mine shafts, is an important commodity. It is derived principally from mature yellow pine and occasionally from red fir. The pieces are 4 feet long, 4 to 6 inches wide, and about 2 inches thick. The average price paid for lagging delivered at the mines is about $16 per 1,000 pieces, and the distance hauled is from 10 to 18 miles.

SHAKE TIMBER.

"Shakes" are a form of shingle used exclusively in this region from an early day for roofing, and to some extent also for weatherboarding (see Pl. CIV, *B*). Except in some of the larger settlements near railroad communications, where sawed shingles can be had, shakes are still in common use. The best shakes are made from sugar pine, which is the timber used most commonly. They are also made from extra clear and straight-grained yellow and Jeffrey pine, and also from white and California red fir; but all are inferior to the sugar pine in wearing qualities. The sugar pine is preferred also because the timber can be rived more easily and because of the greater length of clear trunk available. For the most part, it is only when sugar pine is not available that other timber is used. Shakes are usually 36 inches long, 5 to 6 inches wide, and from one-fourth to one-half inch thick. Sugar pine of perfect quality for making shakes splits so smoothly that the shakes do not require shaving. The market price of shakes is from $5 to $7 per 1,000.

The widespread and long-continued use of sugar pine for shakes has resulted in the destruction and waste of much prime timber. Only a very small part, 15 to 20 per cent of each trunk, can be used, for the reason that the straight-grained portion of the trunk is of limited length; and as soon as the grain of shake bolts shows any twisting, the remainder of the tree is abandoned. A common sight throughout the middle timber belt are the huge partly used trunks of sugar pines felled for shakes. All degrees of waste are seen. After felling and a few trials at riving, some trees are found to be unfit and can not be used at all, while only 20 to 40 feet of other trunks have been used. This waste of good log timber left to rot seems wanton to the last degree, but in former years had some justification in the fact that necessity alone compelled settlers to use good shakes. Moreover, at that time, when the largest quantities of sugar pine were cut for shakes, there were few or no sawmills for utilizing the waste timber. There is, however, little excuse at the present time for the continuance of this waste, which is still to be seen in the middle timber belt (see Pl. CXI, A.)

FENCING TIMBER.

In the immediate vicinity of the larger settlements fencing is done with sawed pine and fir lumber and oak or incense cedar posts. The majority of ranches in the agricultural districts are fenced with barbed wire and rock oak and cedar posts; while in the timbered mountain districts sawed fencing is used only at occasional road stations. Barbed wire and split incense cedar posts and rails are most common in this region. Lodgepole-pine logs are also used in the range of this species for sheep and cattle corrals and other fencing. In some parts of the yellow-pine and upper timber belt thousands of acres of timber land are fenced for holding cattle by felling the largest trees in a line so as to form a continuous barrier. If skillfully felled, the huge trunks of incense cedar, sugar pine, yellow and Jeffrey pine, white and red fir, form effective and durable fences. However, the millions of feet of prime saw timber destroyed by this method of fencing is strikingly disproportionate to the amount of timber legitimately required to fence the land in the ordinary way.

Incense-cedar rails and posts are the lightest and most durable of all fencing timbers in this territory, and wherever available are generally used in preference to any other kind. There is a good demand for post timber of this kind throughout the settled districts, but posts are rarely hauled farther than 18 or 20 miles to supply this demand. The extensive use of incense cedar posts and rails in the past has resulted in the disappearance of almost all large trees within the above distance from settlements. The species is, however, very persistently reproduced in these sections, and if allowed to grow will furnish a continuous supply.

FUEL.

The fuel of this territory is very largely wood. Coal is used only in the southern and western border settlements near railroad communications. The trees furnishing fuel are chiefly gray pine, yellow pine, California black oak, rock oak ("white oak"), highland oak ("live oak"), and California white oak. Red alder is used occasionally, as is also red fir and incense cedar. California red fir and lodgepole pine are used to some extent by settlers in the upper timber belt. Gray

A. SOUTH FORK OF COSUMNES RIVER, NEAR COYOTEVILLE.

B. DENSE SECOND GROWTH OF YELLOW PINE.

pine, yellow pine, rock oak, and highland or "live oak" are extensively used for domestic wood, and the latter is most highly prized. Fourteen-inch "live oak" readily commands the enormous price of $4 and $5 per cord at settlements. Four-foot wood of other oaks brings $6 to $7. Gold-mining plants consume the greatest quantities of cordwood, which is derived entirely from gray and yellow pine (see Pl. CXIV, *A*). The wood of these species contains a great deal of turpentine, and is therefore considered the best fuel for making steam. Yellow-pine fuel is superior to the gray pine. Large mines consume from 2,000 to 3,500 cords of 4-foot pine wood annually. The prices paid for this wood delivered at the mines varies from $3 to $6 per cord. The distance hauled is 7 to 18 miles.

With the present demand for pine fuel, yellow-pine woodland on the lower border of the middle timber belt can be profitably managed for cordwood. To be fully productive such woodland needs only protection against fire, and cutting so regulated that four to six seed trees per acre are left to insure rapid reproduction. Young yellow-pine forests 25 to 50 years old are now cut clean in the region of mining districts, and no seed trees are purposely left. As already shown, however, seed trees or groups are sometimes left by accident, and the cut-over areas are re-covered by the same pine. The gray pine, although far less productive than the yellow pine, could be made to give similarly good returns on otherwise barren foothills.

STANDING COMMERCIAL TIMBER.

The standing commercial timber of this territory is pine and fir, and is confined chiefly to the middle timber belt. The lower belt yields no saw timber. Considerable fir lumber could be obtained from the lower levels of the upper belt, but the rough, inaccessible nature of this region is likely to make lumbering in such high altitudes unprofitable for some time to come. These forests are not likely to be lumbered until the more valuable timber of the middle belt is severely depleted, and it is believed this can not occur within twenty-five years or more.

As already stated in describing the distribution of various timber species, the original area of commercial timber has been considerably reduced by complete clearing. Only a small percentage of such clearing has been done for securing agricultural land. The major part of forest land has been cleared by lumbering operations, since which it has been abandoned and more or less recovered by the same lumber species. A still smaller percentage of originally well-stocked forest land has been culled. Cuttings of this kind have been confined largely to the immediate vicinity of roadways, where mostly sugar pine has been taken out for shakes. The accompanying maps show the cut-over forest land which must be regarded now only as woodland. The markedly persistent reproduction of yellow pine and other timber species on these lands indicates, however, that they could be profitably maintained in forest if protected from fire and conservatively managed.

The timber forests of commercial value contain yellow pine, Jeffrey pine, sugar pine, white fir, red fir, and incense cedar. An examination of the following table will show the percentage of each species found in these forests. For completeness the percentage of stand has been given for a few other species also. The percentages of stand given are based on an extensive study of sample areas selected from representative parts of the various timber belts.

Table showing the percentage of stand for the principal timber trees, in localities where they are found.

Species.	Per cent of total stand.
Yellow pine	45 to 50.
Jeffrey pine	5; 30 to 40 on small areas.
Sugar pine	5 to 20.
White fir	30 to 45.
Red fir	2 to 5; 40 on small areas.
Incense cedar	20 to 30.
Big tree	1 to 3 on limited areas.
California red fir	40 to 100.
Lodgepole pine	50 to 100.
Silver pine	5 to 15.
Black hemlock	10 to 25.

As a basis for computing the yield of timber per acre, the trees on a large number of sample acres were measured. A few of these sample areas are presented in the accompanying tables, a study of which will give an accurate idea of the actual composition and character of the forests. Table 1 shows the number and size of each kind of tree, obtained by actual count and measurement, on sample areas so selected as to fairly represent the stand of timber in all parts of the territory. Table 2 gives the same species grouped so as show a comparison of dimensions and number of trees of the same species found on the different sample areas. Table 3 gives the average size and average number of different kinds of trees for all sample areas. The figures derived from these and other measurements are regarded as sufficiently representative of the entire timbered area to form a basis for the acre yields given, and also for the estimated total stand of commercial timber.

The acre yield of merchantable timber in these regions varies from 2,000 to 50,000 feet B. M., giving an average acre yield of about 20,000 feet for the middle belt, and 3,000 feet for the upper belt.

acre).

	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	Average diameter (inches).	Average height (feet).	Number of trees.
Jeffre	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	46.8	150	6
Whit	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	46.2	182	15
Whit	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	47.3	175	3
Yello	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	42.0	161	2
Incer	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	36.4	90	11
Sugar	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	49.8	190	2
Yello	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	40.0	172	19
Incer	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	62.5	89	4
Suga	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	44.8	185	16
Whit	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	37.0	168	5
Incer	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	49.0	97	2
Califo	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	28.2	50	7
Yello	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	39.5	176	8
Incer	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	34.8	100	12
Califo	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	38.1	130	11
Whit	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	35.7	158	20
Lodg	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	27.6	60	14
Whit	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	43.9	160	8
Sugar	1	1	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	62.5	190	4
Incer	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	51.2	98	4
Califo	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	34.6	145	47
Whit	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	37.4	166	20
Califo	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	35.0	139	4
Incer	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	35.5	88	3
Jeffre	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	39.0	125	1
Sugar	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	40.5	187	2
Jeffre	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	43.7	151	9
Weste	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	26.5	120	11
Califo	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	27.8	127	41
Black	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	22.5	70	15
Jeffre	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	50.5	152	10
Whit	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	39.6	145	8
Incer	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	44.0	97	5
Sugar	....	....	....	....	....	....	....	1	....	....	1	....	....	....	....	....	....	....	65.8	186	4
Jeffre	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	55.9	147	3
Whit	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	45.2	169	4
Whit	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	40.4	171	6
Red f	....	....	....	....	1	....	1	....	....	....	1	1	....	....	....	....	....	....	53.3	160	13
Incer	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	15.7	75	2
Sugar	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	28.1	110	2
Califo	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	21.8	122	16
Lodg	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	18.8	65	28
Weste	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	23.3	115	4
Incen	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	42.8	73	3
Red f	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	44.1	146	2
White	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	37.1	157	15
Sugar	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	37.6	156	3
Yello	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	45.4	164	4
Yello	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	24.2	145	19
Sugar	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	35.0	118	4
Incen	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	23.4	70	6
Califo	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	23.0	50	1
Yello	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	35.0	143	4
Red f	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	39.2	154	7
Incen	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	49.5	76	2
Califo	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	27.6	48	2
Yello	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	25.6	145	17
Incen	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	21.7	62	9
Sugar	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	37.0	120	1
Califo	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	18.0	39	1
Incen	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	44.3	87	5
Yello	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	45.5	158	13
Red f	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	40.6	152	12
Incen	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	34.2	90	5
Sugar	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	60.0	200	1
White	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	41.6	170	3

land. The markedly persistent reproduction of yellow pine and other timber species on these lands indicates, however, that they could be profitably maintained in forest if protected from fire and conservatively managed.

The timber forests of commercial value contain yellow pine, Jeffrey pine, sugar pine, white fir, red fir, and incense cedar. An examination of the following table will show the percentage of each species found in these forests. For completeness the percentage of stand has been given for a few other species also. The percentages of stand given are based on an extensive study of sample areas selected from representative parts of the various timber belts.

Table showing the percentage of stand for the principal timber trees, in localities where they are found.

Species.	Per cent of total stand.
Yellow pine	45 to 50.
Jeffrey pine	5; 30 to 40 on small areas.
Sugar pine	5 to 20.
White fir	30 to 45.
Red fir	2 to 5; 40 on small areas.
Incense cedar	20 to 30.
Big tree	1 to 3 on limited areas.
California red fir	40 to 100.
Lodgepole pine	50 to 100.
Silver pine	5 to 15.
Black hemlock	10 to 25.

As a basis for computing the yield of timber per acre, the trees on a large number of sample acres were measured. A few of these sample areas are presented in the accompanying tables, a study of which will give an accurate idea of the actual composition and character of the forests. Table 1 shows the number and size of each kind of tree, obtained by actual count and measurement, on sample areas so selected as to fairly represent the stand of timber in all parts of the territory. Table 2 gives the same species grouped so as show a comparison of dimensions and number of trees of the same species found on the different sample areas. Table 3 gives the average size and average number of different kinds of trees for all sample areas. The figures derived from these and other measurements are regarded as sufficiently representative of the entire timbered area to form a basis for the acre yields given, and also for the estimated total stand of commercial timber.

The acre yield of merchantable timber in these regions varies from 2,000 to 50,000 feet B. M., giving an average acre yield of about 20,000 feet for the middle belt, and 3,000 feet for the upper belt.

Table showing a comparison of the numb

Species.	Sample area No.	Number of trees o																											
		11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
Jeffrey pine	1																				1						1		
White fir																	1		1		2		1					1	
White fir	2																												
Yellow pine																										1			
Incense cedar																			1		1				1	1		1	2
Sugar pine																													
Yellow pine	3										1								1		2			2		1	1		
Incense cedar																													
Sugar pine	4														1						1	1	1		1		1		
White fir											1									1									1
Incense cedar																													
California black oak	5							1				1	1				2									1			
Yellow pine			1					1							1						2								
Incense cedar								1					1	1		1	1						2						
California red fir	6												1		1					1								1	1
White fir																	1				3	1	2	1	2		2	2	1
Lodgepole pine	7		1		1		1				1			1	2			1					1	2		1	1		
White fir	8																				1						1		2
Sugar pine																													
Incense cedar																				1					1				
California red fir	9				2		1	2	1		1		4	1	1	1	1	2	1		2	1	4	2	1	1		2	1
White fir	10											1				1		1	1		2		3						2
California red fir																		1				1							1
Incense cedar																					1						1		
Jeffrey pine																													
Sugar pine																	1												
Jeffrey pine	11																									1			
Western white pine	12					1	1		1			1	1						1		2		1		1	1			
California red fir					1	1	2		3	2	3		1	2	2			4		1	3	5	1	1	2	2	1	1	2
Black hemlock			1	1			2	1		1		1		3			1	2		1				1					
Jeffrey pine	13																					1							
White fir																					1								
Incense cedar	14																				1								
Sugar pine																													
Jeffrey pine																													
White fir																													
White fir	15													1				1		1				1					
Red fir																	1		1	1				1					
Incense cedar				1					1																				
Sugar pine																	1				1								
California red fir	16		1		1		1		2	3	2				1	1	1		2				1						
Lodgepole pine		1	4	1		1	1	4	3	2	2	1	2	2	3			1											
Western white pine							1				1		1										1						
Incense cedar	17																												1
Red fir																													
White fir								1						1							1	1			2			2	2
Sugar pine																						1				1			
Yellow pine																									1				
Yellow pine	18		1	2		2	1		2	1	1				1	1	1				1		1	2		1	1		
Sugar pine														1								2				1			
Incense cedar							1		1				1		1	1							1						
California black oak														1															
Yellow pine	19																1				1							1	
Red fir																			1		1						1		
Incense cedar																										2			
California black oak										1															1				
Yellow pine	20			1			2				1				1	2	1		1	1	2	2	1				1		
Incense cedar			1		2				2					1					1	1	1								
Sugar pine																												1	
California black oak									1																				
Incense cedar	21															1													
Yellow pine																									1	1			
Red fir	22																			2	2	1					1		
Incense cedar									1							1				1									
Sugar pine																													
White fir															1														

Table showing a comparison of the number and

Species.	Sample area No.	Number of trees																											
		11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
Sugar pine	2																												
	4														1						1	1	1		1		1		
	8																												
	10																1												
	14																												
	15																1				1								
	17																					1				1			
	18													1								2				1			
	20																											1	
	22																												
Yellow pine	2																									1			
	3										1								1		2			2		1	1		
	5		1					1							1						2								
	17																								1				
	18		1	2		2	1		2	1	1				1	1	1				1		1	2		1	1		
	19																1				1							1	
	20			1			2				1				1	2	1		1	1	2	2	1				1		
	21																								1	1			
Jeffrey pine	1																				1						1		
	10																												
	11																									1			
	13																					1							
	14																												
Lodgepole pine	7		1		1		1				1			1	2			1					1	2		1	1		
	16	1	4	1		1	1	4	3	2	2	1	2	2	3			1											
Western white pine	12					1	1		1			1	1						1		2		1		1	1			
	16						1				1		1										1						
Red fir	15																1		1	1				1					
	17																												
	19																		1		1						1		
	22																			2	2	1					1		
White fir	1																1		1		2		1					1	
	2																												
	4										1									1									1
	6																1				3	1	2	1	2		2	2	1
	8																				1						1		2
	10											1				1		1	1		2		3						2
	13																				1								
	14																												
	15													1				1		1				1					
	17							1						1							1	1			2			2	2
	22														1														
California red fir	6												1		1					1								1	1
	9				2		1	2	1		1		4	1	1	1	1	2	1		2	1	4	2	1	1		2	1
	10																	1				1							1
	12				1	1	2		3	2	3		1	2	2			4		1	3	5	1	1	2	2	1	1	2
	16		1		1		1		2	3	2				1	1	1		2				1						
Black hemlock	12		1	1			2	1		1		1		3			1	2		1				1					
Incense cedar	2																		1		1				1	1		1	2
	3																												
	4																												
	5							1					1	1		1	1						2						
	8																			1					1				
	10																				1						1		
	14																				1								
	15			1					1																				
	17																												1
	18						1		1				1		1	1							1						
	19																									2			
	20		1		2				2					1					1	1	1					1			
	21															1													
	22								1							1				1									
California black oak	5							1				1	1				2									1			
	18													1															
	19									1															1				
	20								1																				

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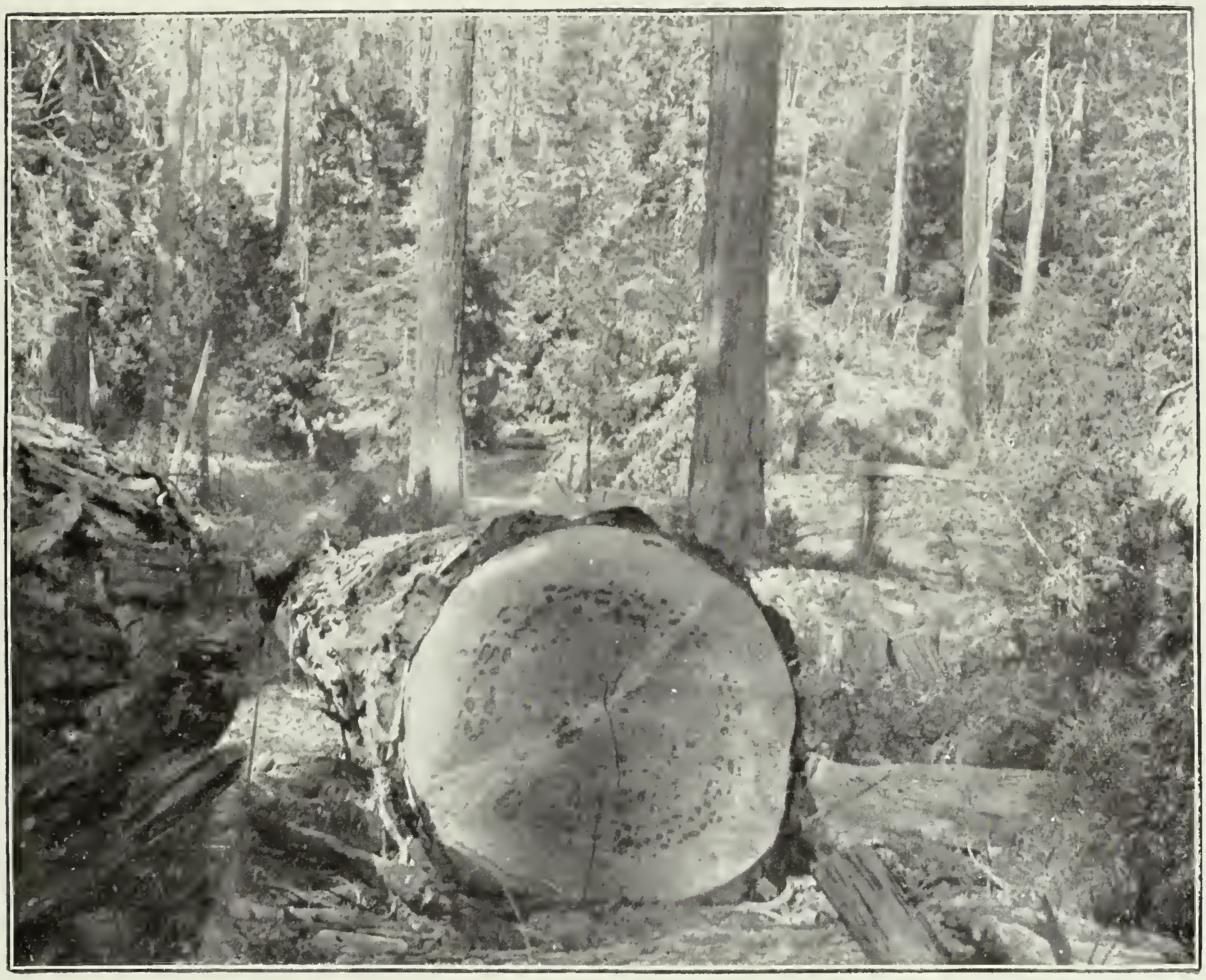
le areas.

63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	Average diameter (inches).	Average height (feet).	Number of trees.
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	49.8	190	2
....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	44.8	185	16
1	1	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	62.5	190	4
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	40.5	187	2
....	....	....	....	....	....	....	1	....	....	1	....	....	....	....	....	....	....	65.8	186	4
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	28.1	110	2
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	37.6	156	3
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	35.0	118	4
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	37.0	120	1
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	60.0	200	1
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	42.0	161	2
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	40.0	172	19
....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	39.5	176	8
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	45.4	164	4
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	24.2	145	19
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	35.0	143	4
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	25.6	145	17
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	45.5	158	13
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	46.8	150	6
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	39.0	125	1
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	43.7	151	9
....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	50.5	152	10
....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	55.9	147	3
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	27.6	60	14
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	18.8	65	28
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	26.5	120	11
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	23.3	115	4
....	....	....	....	1	....	1	....	....	....	1	1	....	....	....	....	....	....	53.3	160	13
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	44.1	146	2
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	39.2	154	7
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	40.6	152	12
....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	46.2	182	15
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	47.3	175	3
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	37.0	168	5
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	35.7	158	20
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	43.9	160	8
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	37.4	166	20
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	39.6	145	8
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	45.2	169	4
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	40.4	171	6
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	37.1	157	15
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	41.6	170	3
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	38.1	130	11
1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	34.6	145	47
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	35.0	139	4
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	27.8	127	41
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	21.8	122	16
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	22.5	70	15
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	36.4	90	11
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	62.5	89	4
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	49.0	97	2
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	34.8	100	12
....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	51.2	98	4
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	35.5	88	3
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	44.0	97	5
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	15.7	75	2
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	42.8	73	3
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	23.4	70	6
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	49.5	76	2
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	21.7	62	9
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	44.3	87	5
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	34.2	90	5
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	28.2	50	7
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	23.0	50	1
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	27.6	48	2
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	18.0	39	1

Table showing average diamete

Species.	Number of trees of vari																													
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Sugar pine	....	....	....	....	....	....	....	....	....	....	....	....	1	1	....	2	....	....	....	2	4	1	....	1	2	1	1	....	....	1
Yellow pine	....	2	3	....	2	3	1	2	1	3	....	....	....	3	3	3	....	2	1	8	2	2	4	2	4	3	1	....	....	1
Jeffrey pine	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	....	....	....	1	1	....	....	2	1
Lodgepole pine	1	5	1	1	1	2	4	3	2	3	1	2	3	5	....	....	2	....	....	....	....	1	2	....	1	1	....	....	1	....
Western white pine	....	....	....	....	1	2	....	1	....	1	1	2	....	....	....	....	....	1	....	2	....	2	....	1	1	....	....	....	....	....
Red fir	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	2	3	3	1	....	1	....	....	2	....	....	3	....
White pine	....	....	....	....	....	....	1	....	....	1	1	....	2	1	1	2	2	2	2	10	2	6	2	4	....	3	5	8	6	5
California red fir	....	1	....	4	1	4	2	6	5	6	....	6	3	5	2	2	7	3	2	5	7	6	3	3	3	1	4	5	2	2
Black hemlock	....	1	1	....	....	2	1	....	1	....	1	....	3	....	....	1	2	....	1	....	....	....	1	....	....	....	....	....	....	....
Incense cedar	....	1	1	2	....	1	1	5	....	....	....	2	2	1	4	1	....	2	3	4	....	3	....	2	3	1	1	3	4	4
California black oak	....	....	....	....	....	....	1	1	1	....	1	1	1	....	....	2	....	....	....	....	....	....	....	1	1	....	....	....	....	....

	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	Total number of trees.	Total number of sample areas.	Average diameter for total number of trees (inches).	Average height for total number of trees (feet).	Average age (years).
S	1	....	....	....	1	....	....	1	....	....	....	....	....	....	....	39	10	47.7	164.2	375
Y	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	86	8	37.9	158.0	380
J	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	29	5	47.5	145.0	260
L	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	42	2	23.6	62.5	135
W	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	15	2	24.9	117.5	210
R	....	1	....	1	....	....	....	1	1	....	....	....	....	....	....	34	4	44.6	153.0	350
W	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	107	11	41.2	166.0	290
C	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	119	5	32.0	132.6	275
B	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	15	1	22.5	70.0	185
I	....	....	....	....	1	....	....	....	....	....	....	....	....	....	1	73	14	40.9	86.0	150
C	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	11	4	24.5	47.0	190



A. DEFECT IN ALL LARGE INCENSE-CEDAR TIMBER.

B. YELLOW-PINE "STUDDING" SKIDDED FOR HAULING TO GOLD MINES.

Following are the statistics of area and estimated stand of timber in each of the six quadrangles examined:

Land classification in Placerville quadrangle, California.

	Square miles.
Cultivable lands	178
Lands covered with chaparral	317
Grazing lands	2
Burned lands	5
Cut lands, restocking with timber	122
Culled lands	162
Virgin timber	152
Total	938

The total stand of timber upon this quadrangle is estimated at 1,600 million feet B. M. The average stand of timber per acre on the timbered land, including the culled land, is 8,000 feet B. M.

Land classification in Jackson quadrangle, California.

	Square miles.
Cultivable lands	373
Lands covered with chaparral	349
Burned lands	23
Cut lands, restocking with timber	175
Culled lands	18
Total	938

The total stand of timber remaining upon the culled lands is estimated at 40 million feet B. M. There is no virgin forest land upon this quadrangle.

Land classification in Pyramid Peak quadrangle, California.

	Square miles.
Barren lands (partly chaparral-covered foothills and partly high mountain summits)	110. 5
Grazing lands	7. 5
Culled lands	148. 0
Lands covered with virgin timber	642. 0
Total land area	908. 0

The total stand of timber upon this quadrangle is estimated at 3,400 million feet B. M., an average of 6,700 feet per acre of timbered land.

Land classification in Big Trees quadrangle, California.

	Square miles.
Cultivable land	7
Barren lands, consisting in part of chaparral and in part of rocky summits	164
Grazing lands	4
Burned lands	2
Cut lands, restocking	89
Culled lands	104
Lands covered with virgin timber	564
Total	934

The total stand of timber upon the quadrangle is estimated at 3,750 million feet B. M. The average stand of timbered land per acre is 7,700 feet.

Land classification in Markleeville quadrangle, California.

	Square miles.
Lands covered with chaparral	318
Grazing lands	283
Lands covered with virgin timber	322
Total land area	923

The total stand of timber upon this quadrangle is estimated at 320 million feet B. M. The average stand per acre of timbered lands is 1,500 feet.

Land classification in Dardanelles quadrangle, California.

	Square miles.
Chaparral-covered lands	240
Grazing lands	39
Lands covered with virgin timber	659
Total	938

The total stand of timber upon the quadrangle is estimated at 3,000 million feet B. M., giving an average stand per acre of 7,100 feet.

The total stand of timber upon these six quadrangles is estimated at 12,110 million feet B. M.

Of the total area of Stanislaus Reserve—1,080 square miles—924 square miles were included in this examination. Of this area, the lands are classified as follows:

Land classification in Stanislaus Reserve, California.

	Square miles.
Barren, consisting mainly of high, rocky lands	251.0
Grazing lands	32.5
Timbered lands	640.5
Total	924.0

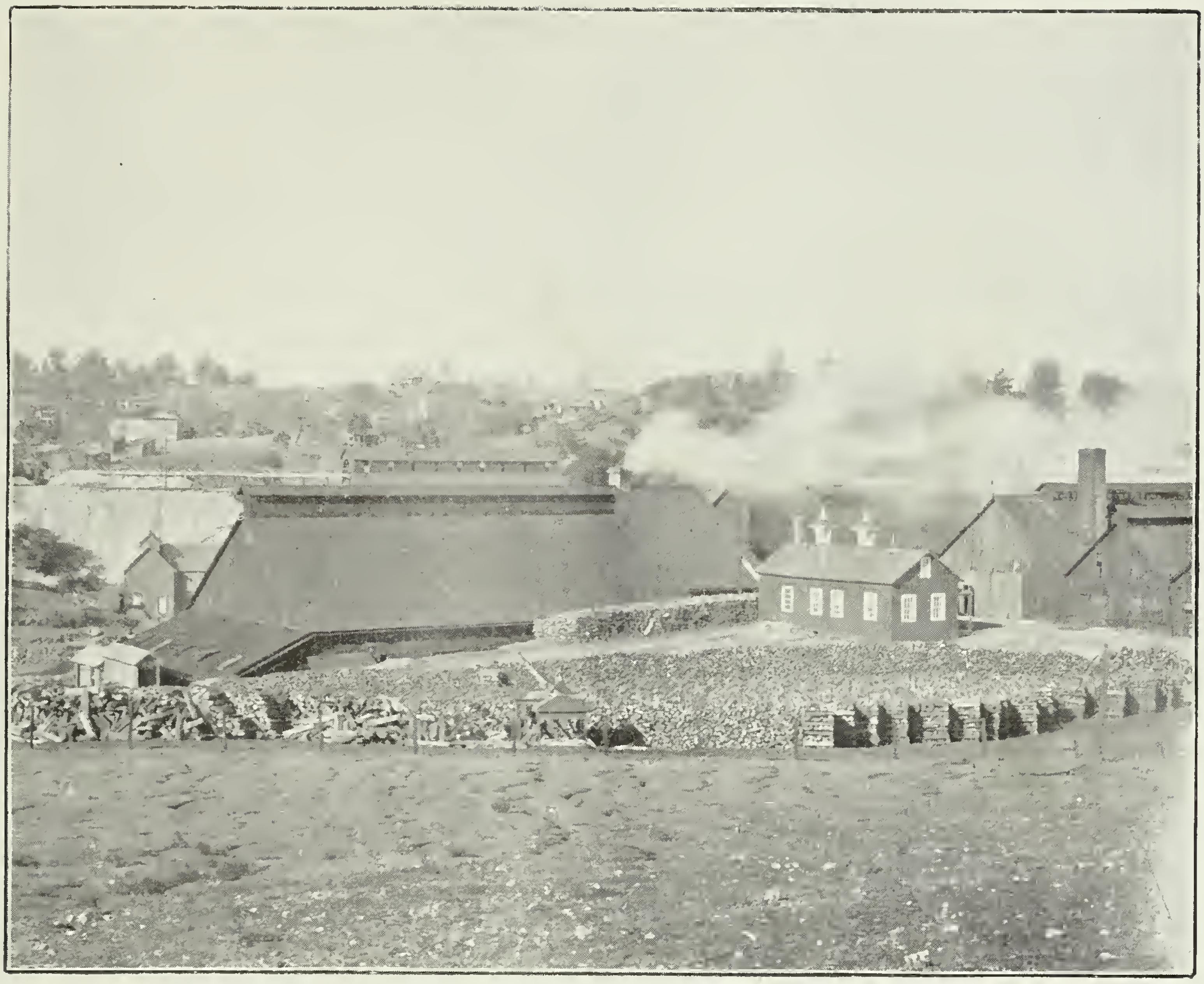
The total stand of timber upon this area is estimated at 2,000 million feet B. M., giving an average stand per acre of 5,000 feet.

Of the total area of Lake Tahoe Reserve—213 square miles—193.5 square miles were examined. The following is the classification of these lands:

Land classification in Lake Tahoe Reserve, California.

	Square miles.
Barren, consisting of high, rocky summits	58.0
Grazing lands	3.0
Culled	3.0
Timbered lands	129.5
Total	193.5

The total stand of timber upon this area is estimated at 322.5 million feet B. M. The average stand per acre is nearly 3,000 feet.



A. LARGE MINING PLANT AT ANGELS CAMP, SHOWING THE GREAT QUANTITY OF YELLOW-PINE CORD WOOD CONSUMED.

B. CANYON OF COYOTE CREEK, LOOKING NORTH FROM A POINT 2 MILES SOUTH OF VALLECITO.

REDUCTION AND MODIFICATION OF FORESTS BY VARIOUS INDUSTRIES AND THEIR EFFECT ON REPRODUCTION.

LUMBERING AND OTHER TIMBER-CONSUMING INDUSTRIES.

The largest areas of forest land have been denuded and cut over for saw timber and mining timber. Altogether, shake making has also made large inroads on the prime sugar pine. As this pine occurs in mixture only, the more extensive cutting for shakes—sometimes taking the sugar pine clean—has resulted in only a thinning of the original forest. The enormous amount of timber wasted by shake-makers has already been referred to. Naturally, the constant demand, from an early date, for shake timber has carried this industry over a large part of the middle timber belt. The major part of this cutting has, however, been carried on along and near the principal wagon roads. Occasional transient settlements were formed in regions of the largest supply of sugar pine, and continued for a number of years, but with the failure of timber these settlements were moved to other points. Squaw Hollow was originally a shake makers' settlement of considerable size, but has long since disappeared, along with its once abundant supply of sugar pine. It was situated between the Calaveras and Stanislaus big-tree groves.

Unlike the cuttings for sawmills, those for shake making commonly left small trees, and occasional large trees unfit for riving on account of a too twisted grain. As a result, with few exceptions, the forests cut over by shake makers have not been deprived of seed trees, and there has been a continued reproduction of sugar pine (see Pl. XCVI, *A*).

But the cutting for lumber and mining timber has been quite different. Considerable areas have been stripped, as shown in the accompanying maps (Pls. LXXXV–XC, in atlas). As a consequence of clearing, the reproduction of all the species removed has been prevented or retarded to a great extent. With the subsequent ravages of fire, some cut-over lands have remained in a denuded state for many years, and are still in this condition. Moreover, the proportions of the original composition have been materially changed, because, even under the same circumstances, all the tree species concerned are not equally persistent in reproducing themselves. The sugar pine is the least so. The yellow pine, incense cedar, and white fir are persistent species, and are the first to come back to denuded lands; and the proportion in which they form the second growth varies according to the nearness and abundance of seed trees of each kind. Under all circumstances the yellow pine will return in the largest proportion, while the sugar pine, originally a considerable part of the forest, is likely to be the last to come back and may require many years to establish its former proportion of stand in the forest.

Conservative cutting for sawmills, in place of the prevailing method of stripping the land, would not disturb the advantageous proportions of mixture present in forests not yet lumbered. Provision could then be made for the reproduction of all useful timber trees.

The method of lumbering employed in this territory from the earliest time to the present is very wasteful of timber. A very common sight, in all districts where lumbering is going on, is the enormous waste of tops. The clear trunk is cut into logs, and the remainder of the stem left (see Pl. CXI, *A*). The size of the tops left is from 18 to 36 inches or more in diameter at the large end, with a total length of 25 to 40 feet. This timber is usually sound, but has limbs throughout its length, and is therefore considered undesirable. An estimate of this waste gives from 3,000 to 5,000 feet B. M. per acre. To one familiar with the extreme economy of timber now practiced in the depleted pine forests of the East, this waste is wanton. Without discussing the reasons for this practice, among which are urged that top lumber is too knotty to be saleable and that there is enough clear timber, the neglect of so much top timber makes forest fires very destructive. The lumberman himself is in position to feel this, for cases were seen where the big timber not yet lumbered out was destroyed or greatly damaged by uncontrollable fires in masses of tree tops (see Pl. CVI, *A*). A more complete destruction also of all young growth takes place in such localities than is possible from the ordinary light surface fires.

The cutting of cord wood and mining timber is attended with little or no waste. This is not from design, but chiefly because mining timber and wood are cut in thinly stocked parts of the pine belt, and it is most profitable to be economical. The entire trunks are worked up in cutting cord wood, leaving only the branches, while the tops left from studding timber are cut into cord wood (see Pl. CXII, *B*). Such methods are ideally thrifty. The branches left soon decay, and altogether there is much less débris left for fires than there is in the track of the lumberman.

GRAZING.

Grazing in this region is mostly by sheep, goats, and cattle, and to a much less extent by horses. Next to mining, grazing is the oldest industry of the region. Its importance is also very great, and in considering the possible evil effects the industry may have on the forests, this must be fully borne in mind. The bare condition of the surface throughout the forests is so easily referable to grazing and the latter is thus so apparently destructive to forest reproduction and the conservation of water that a very careful study must be made of all possible conditions bearing on the subject before a fair conclusion can be drawn. The effect of grazing on reproduction and water flow is a subject of great contention among those interested in grazing privileges on public forest lands and those believing such rights should be denied. The opinions given and the evidence adduced on both sides seem conclusive from the standpoints of the contestants. This may argue that enthusiasm on the one side and vital interests on the other have overlooked some facts which should be appreciated by both sides. Carefully considered, the propriety of grazing forest land in this territory can not be denied nor affirmed by the study of any one locality, a kind of investigation which is believed to have formed the basis of opinion for and against grazing privileges.

The investigation of the effects of grazing on forest growth and its protective functions involves a careful consideration of the relation of forest fires to grazing. Just how far the one or the other may be responsible for certain conditions avowedly unfavorable to forest growth is difficult to show, but that the combined effects of fire and grazing are or may be damaging to forest reproduction and the conservation of water can not be denied.

In traversing the timbered portions of this territory the observer is impressed with the following facts. First, in unfenced forests: The general lack of herbaceous growth and irregular reproduction of timber species; the general absence of small-sized timber intermediate between seedlings and the large timber. Second, in fenced and otherwise protected forests: The uniform abundance of herbaceous growth; a plentiful reproduction of timber species; the presence of intermediate sizes of small timber. These conditions prevail in proportion to the length of time during which complete protection has been given.

Pls. XCII, *A;* CI, *B;* CII; CV, *A*, and CVI, *B* illustrate clearly the above extreme conditions. The best opportunity offered for observing protected forest conditions was in the Calaveras big-tree grove, which has been protected from all kinds of grazing and almost entirely from fire for 30 to 40 years. Another case of several thousand acres protected for 15 to 20 years was found on and near the headwaters of the North Fork of Tuolomne River. Smaller areas protected for 5 to 15 years were studied at various points in the upper timber belt; while the effects of unchecked fire, promiscuous grazing, and the separate effects of sheep and cattle grazing were observed throughout the unprotected forests of the entire region. These latter conditions have prevailed more or less for 40 or 50 years. No check has been given to the annual fires, and practically no restraint has been put upon the number of animals grazed in the region.

As a rule, there is no promiscuous grazing of cattle and sheep on the same range during the same season, for the reason that cattle will not graze on a range over which sheep have previously gone. The two kinds of grazing are separated, each continuing more or less over its own range for one or several seasons. Sheep and cattle ranges on public and other unfenced forest lands are held mainly by the right of priority, or sometimes by the common agreement of sheepmen and cattlemen. Most of the cattlemen claim to own summer ranches, in the vicinity of which they endeavor to maintain a free range for their stock. At the present time very few sheepmen have summer ranches in the lumbered regions, but select such ranges as are not seized for cattle, and assiduously encroach upon adjoining cattle ranges whenever possible. There is evidence that years ago there were many permanent sheep ranches in various parts of this territory. None of these are maintained now. The sheepmen appear to be wanderers, while the cattlemen seem to hold the balance of power in point of preferred range land. This advantage is strengthened also by a right to graze in the forest reserves, from which the sheepmen are nominally excluded by law.

It is evident, however, that, although cattle grazing is now carried on over the best range, sheep grazing has, on the whole, obtained over a far more extensive territory and for a much longer time. As is well known, there is a striking difference between the effects of sheep and cattle grazing on vegetation. This is best seen in protected ranges used by cattle and those used exclusively by sheep. The latter feed so closely that if the range is overstocked for any length of time there will not be a vestige of forage left. Cattle feed much less closely, and even in overstocked ranges, unless the animals are confined by fences, the grazing is not so continuously close and is never wholly destructive to herbaceous plants. The animals wander much, and will even grow thin when a habit of closer feeding would give them sufficient food. There is one other important difference between the grazing of sheep and cattle. The latter usually feed singly, or not more than a few individuals together, while sheep almost always feed in close bands. As a result, the surface of the ground is more continuously trampled by sheep than by cattle, from which it follows that with closer feeding and closer trampling sheep may do greater damage to low vegetation than cattle. Just these differences can be observed in localities where the two kinds of grazing are separate. Moreover, it may be said that several bands of sheep seen in this territory were so driven by hunger and the lack of all other forage that they ate small conifer seedlings, browsed young firs and pines, and where these were not available they devoured even the fallen dead pine and fir leaves. Cattle never browse on conifers, even under the severest stress of hunger, but do feed on broad-leaf shrubs and young trees within their reach.

Excepting in high mountain meadows, all of which are fenced and which are grazed by cattle, the principal forage for sheep and cattle on the open forest range consists of a few very hardy shrubs and low broad-leaf trees. There are practically no grasses or other herbaceous plants. The forest floor is clean (see Pls. CI, *B;* CIII, *A*, and CIV, *A*). The writer can attest the inconvenience of this total lack of grass forage, for in traveling over nearly 3,000,000 acres not a single day's feed for saddle and pack animals was secured on the open range. This is in striking contrast to the rich forage range in the timber forests of the Rocky Mountains. Barrenness is, however, not an original sin. From a study of long-protected forest land in the same region, and from the statements of old settlers, it is evident that formerly there was an abundance of perennial forage grasses throughout the forests of this territory. A dense growth of these grasses and many other herbaceous plants are plentiful now in all long-protected forests, whether grazed or not by cattle and horses. It is also true that the severest annual surface fires kill these plants only to the ground; unless uprooted they sprout up the following season. It would seem that this bare condition of the surface in the open range has been produced only through years of excessive grazing by millions of sheep—a constant overstocking of the range.

The inference, however, that sheep grazing is largely, if not entirely, accountable for the lack of forage plants in these forests can not at present be made to include entirely the destruction of young seedling trees. Nor can it be concluded that a limited number of sheep may not be grazed without completely baring the surface.

The more important consideration in this matter is the kind of damage and the manner in which sheep grazing may affect the usefulness of timber and protective forests. Unquestionably many millions of tree seedlings have been trampled to death by sheep, but frequent forest fires have also gone over the same ground. With the evidence now at hand all that can be safely said is that together fires and excessive grazing have reduced the ground cover to almost nothing. What the one has left the other has most likely destroyed.

To determine exactly how much damage sheep grazing does to reproduction would require extended careful study of sheep-grazed forest land entirely free from fire; but, carefully considered, there is a close relationship between the origin of many forest fires and sheep grazing. How generally sheep herders are accountable elsewhere for fires can not be stated, but the writer's observations in the region under consideration show that a large number of fires are due to the presence of sheep herders. Some of these fires were due to carelessness and some were purposely set. Several fires destroyed thousands of conifer seedlings and also set fire to hundreds of acres of large standing pines previously burned in the trunk and thus continued this peculiar gradual destruction of timber which is going on so generally from year to year (see Pl. CI, *B*.)

These fires proceed from neglected camp fires, from purposely fired fallen timber, and also from the deliberate setting of fires in high chaparral. Fallen timber forms troublesome barriers to driving sheep along regular routes, and the herders set fire to these logs, usually as they are leaving a "fed-out" range, in order that the way may be open on their return. No less than seventeen fires of this kind were found on the trail of one band of sheep, covering a distance of 10 miles. The other kind of burning referable to sheep herders occurs in high manzanita and ceanothus chaparral. This brush finally grows so high that sheep can not feed from it, and in places is often so dense that they can not pass through it. These areas are burned over either to produce low sprouts or for the double purpose of feed and access. It frequently requires two seasons' burning to clear away manzanita brush—the first to kill the brush and the second to consume the dead, horny stems. Frequent fires of this kind destroy all young tree growth within the area burned, for, when once started, even the green manzanita burns very fiercely.

In conclusion, it may be again stated that surface denudation of forest land is general throughout the middle timber belt and in the lower part of the upper belt. It is believed that the excessive sheep grazing of the past and present, together with the fires known to be caused by sheep herders, have contributed very largely to the production of this bare condition. Proportionately this industry has also retarded forest reproduction and through incidental fires destroyed much young growth and damaged old timber. As a consequence, the general protective functions of the forests have been appreciably lessened, for the bare surface allows a rapid run-off of water and destroys an equable flow of water in streams.

The inference from these conditions is that there should be a prompt regulation of the excesses producing these conditions. The preservation of a most important industry—sheep grazing—and the fullest usefulness of the forests of this region demand such action. An inspection of the region will show that certain areas require immediate exemption from sheep grazing and absolute protection from fire in order to allow a full reproduction in all open ground. This is imperative if the fullest sustained yield of timber is to be secured in these forests, because almost all of the timber now standing is mature. A complete harvesting of this timber would result, as it has in old lumbering operations, in almost total denudation. With some exceptions, reproduction has been so generally suppressed that there is little young timber to replace the old stand within a reasonable time (see Pl. CI, *B*).

Following the establishment of a young forest growth, limited grazing can be practiced for a term of years without fear of retarding reproduction. Adequate regulation of such grazing should, however, not allow the close, successive feeding, of sheep especially, which will denude and extirpate all herbaceous growth, a cover so much needed as a help in preventing surface washing. The thrifty stock raiser of old countries does not graze his pastures into the earth. He limits the number of animals or the time for using a range. In the present region, however, regulation of this kind can not be left to sheep herders, who consider the feed for the season only. Unbiased, competent inspection of this forest range should determine the number of animals and the length of time they should graze in one locality, or whether certain parts of the range should be grazed at all. With this is also needed a perfect enforcement of provisions against violations. Incidentally it may be remarked that the writer's observations of this season show that in a number of cases unless a ranger's warning to sheep herders to leave the forest reserves is accompanied by the power of immediate eviction the request was treated with contempt, or with a reply that "bullets alone will be obeyed."

FOREST FIRES.

EFFECT ON REPRODUCTION AND STANDING TIMBER.

Forest fires have prevailed in this territory since a very early period, and they are still frequent and widespread. There is evidence that a much older forest than is represented in the present growth once existed here and that much of this growth has been gradually destroyed by fire. A very few of these trees—yellow pine, sugar pine, and white fir—are occasionally met with now. They are nearly twice as old as the oldest recent growth and could not well have disappeared through any other agency than fire. What the character of the older fires was is impossible to state. Most likely, however, they were similar to those common in this region to-day. The fires of the present time are peculiarly of a surface nature, and with rare exception there is no reason to believe that any other type of fire has occurred here. Parts of the older forests may have had a deep humus, which, being burned, would have destroyed timber by deep burning at the roots. But there being no humus at the present time, deep burning is impossible. The tree roots are for the most part buried deep in the crevices of bare rock, in gravel, sand, or shale, over which surface fires run annually without the slightest direct injury to the roots. Barring the débris left from timber-cutting, the only food for these fires is the scanty fall of pine and fir needles, irregular patches of low conifer seedlings, and chaparral. In general, these materials limit the fires to surface burning. The destruction wrought is, however, serious. Millions of tree seedlings are destroyed annually in one or another part of the region (see Pl. C, *A*). The exemption of certain localities from fire is a mere accident, and except where special protection is maintained a locality is not likely to be spared longer than a dozen years. This young growth is killed outright save such trees as have grown high enough to escape a complete singeing. Dense stands of yellow pine 25 to 50 years old suffer a thinning every time surface fires run through them, and not infrequently the younger stands succumb entirely. The amount of damage done to young pine forests by surface fires depends largely on whether the burning is accompanied by high winds. With little or no wind the fire may consume the scant litter in a desultory sort of advance, but if fanned by a stiff breeze the flames usually reach the branches and scorch the close-standing crowns. This usually kills even the 40 or 50 year old trees.

The instances in this region where large timber has been killed outright by surface fires are comparatively rare. Two cases only were found, and are shown on the accompanying map (see Pl. LXXXVIII, in atlas). One of these burns involved less than an acre, and the other included several hundred acres. They are exceptional cases, and the killing of the trees is accounted for by the fact that long protection from fire and from all but cattle grazing had resulted in the accumulation of much fallen timber, considerable humus in depressions and on benches, and a dense undergrowth of brush and seedlings. The fires burned deep enough to badly injure the surface roots, which resulted in the subsequent death of the timber.

The most serious and widespread injury to mature timber caused by surface fires is in the gradual hollowing out from year to year of the green trunks near the base. The extent of this damage is very great. In the middle or main timber belt it is scarcely possible to find a tree trunk not blackened by fire, and from 50 to 75 per cent of the trees have fire scars burrowed out in the green wood (see Pls. XCII, *B;* XCIV, *A;* XCIX, *A*, and CII, *A*). These scars are from a few inches to 15 or 20 feet long and from 6 inches to 2 feet wide. Frequently also the trunks are scorched for 30 to 60 feet above the scar. Burning in the scar continues more or less from year to year, and results in felling the tree (see Pl. CIX, *B*). The cause of this peculiar damage is due primarily to the presence of resin on the bark, while the persistence of the burning is due to the resin on the surface of the fire scar. In the first place, the bark of many trees is punctured by woodpeckers in search of borers, which are especially plentiful in yellow pine. A great many sugar pines also have been chipped by shake makers to test the straightness of the grain. Quantities of resin exude from these wounds and smear the trunks down to the ground. Surface fires ignite the inflammable resin, and it burns fiercely, deepening the chip marks and burrowing into the green wood wherever woodpeckers have exposed even the smallest surface. The green wood is so thoroughly charged with resin at the points of injury that the fire persists for a long time, heating the wood to a depth of several inches. After the fire has ceased a congestion of resin follows at this point, and during the next season or two more resin is exuded and smears the scar and adjoining parts. The next fire burrows in deeper. Others follow from time to time, each burning with greater vehemence, until at last the trunk becomes a thin shell and the tree falls. The rapidity and persistence with which these fires burn in the green wood of trunks is almost inconceivable. After the fire has burned well into the trunk the heat produced is very intense, drying out the moisture and drawing out the abundant resin to feed the flames. The pines are damaged more severely at each burning than are the much less resinous firs and incense cedar. Being most persistent in resinous woods, this type of fire is confined chiefly to the middle pine belt region.

The amount of destruction wrought by trunk fires is difficult to estimate, but involves approximately from 1 to 5 per cent of the total stand. It is difficult, also, to determine how many attacks the trees endure before succumbing. The amount burned each time is exceedingly irregular, as are also the periods at which the timber takes fire. Strangely enough, trees with half burned off trunks, and some even more severely damaged, show no signs of declining vigor. Such trees fruit freely and appear vigorous to the last.

ORIGIN OF FOREST FIRES.

The habitual dryness of this region during the summer renders it most susceptible to fire, and therefore the greatest care needs to be taken to prevent very frequent occurrence of fires.

The origin of a large number of forest fires has already been referred to under the heading Reduction and modification of forests by various industries and their effect on reproduction. The causes there described were determined by actual observations, and are believed to account for the majority of fires occurring in the timber belts of this region. This conclusion is strengthened by the fact that the people carrying on grazing, milling, etc., have occasion to use fire in forested regions more than any other class of settlers or sojourners. Sheep herders are campers, and, in addition to carelessness with camp fires, find it to their interest to deliberately set fires under certain conditions. Cattlemen are summer settlers in the forests and have some interest in the suppression of fires through the fact that they maintain fences and rude buildings which would be endangered by carelessness with fire. Moreover, the burning of brush and fallen timber are rarely of the same advantage to these men as to the sheepmen. Cattle are not herded as are sheep in feeding, but allowed to roam at large; and they feed from the tallest brush without difficulty, and otherwise give the ranger little trouble except to see that they do not wander off the range.

Milling operations are productive of fires through carelessness. Jams of tops are frequently set on fire by loggers to open blockaded roads or ways. These fires usually escape and do damage elsewhere. The use of imperfect spark arresters on donkey logging engines is also a source of many fires. A serious fire from this cause was witnessed in timber near the headwaters of Love Creek, where a considerable quantity of standing and cut saw timber was destroyed through the burning of immense quantities of waste tops. Fires occasionally originate from the small clearing operations of settlers in timbered districts. Two fires of this kind escaped from smouldering log heaps and spread through a wide strip of timber.

There are probably comparatively few fires caused by campers and hunters. This is due to the fact that of necessity such camping is confined largely to the vicinity of road stations and ranches where only, for the most part, it is possible to get horse feed. To a great extent this prevents the promiscuous use of fire by these people at points unguarded by settlers. Moreover, as compared with other regions plentifully supplied with game and fish, the depleted supplies of this region offer few inducements to hunters; and hence there are few such excursions.

PRECAUTIONS AGAINST FIRES.

Forest fires were very prevalent during the summer of 1899; so much so that travel through a large part of the territory was at times difficult on account of dense smoke. They began during the latter part of August and continued to increase till near the end of October, when they were put out by snow and rain.

While there is a wholesale fear of forest fires among settlers in the timbered districts, almost no precautions are taken to guard against the spread of fires, except when threateningly near at hand. Permanent settlers in the foothill country express much graver fears of fires from the adjoining timber which are likely to spread wildly through the dead grass and brush of the lower levels. Fires of this kind are not infrequent and often destroy fences, buildings, and hay crops. The entire lack in these sections of green herbaceous vegetation from July to October and the excessive dryness of the ground make the region most susceptible to fire. As a consequence some precautions are taken to prevent the spread of fires in these sections; in fact the safeguards seen here were the only ones found anywhere. They consist in clearing lanes 4 to 10 feet wide across dangerous parts of the country. This requires principally the scraping away of the dead grass from the hard, dry surface. Usually these firebreakers are effective, especially the wider ones. A still more effective break, but more rarely resorted to, is made 15 to 20 feet wide by carefully burning over a strip between two scraped lanes.

PUBLIC SENTIMENT TOWARD FOREST RESERVES.

Nearly all settlers interested in grazing and wood-consuming industries within this territory are opposed to the maintenance of forest reserves. The greatest objection to the reserves is expressed by men concerned in grazing, and of these the sheepmen are the loudest in their denunciation. The past unlimited use of Government mountain forest land for a summer range has made it possible for a large number of settlers to engage in stock raising with little outlay for feed. The range of the foothills is sufficient from November to about the 1st of July; but high mountain forest range must be sought from July to October, during which time there is no green feed in the foothills.

As yet the cattlemen are allowed free range in the reserves, but many of these men are opposed to maintaining the reserves, for fear that cattle may soon be excluded. Sheepmen are bitter in their denunciation of the reserve policy for the reason that they are (at least nominally) excluded from grazing in the reserves. American sheep raisers have usually respected warnings to leave the reserves, and not being able to secure sufficient range elsewhere, have, in some cases, been compelled to reduce their flocks or go out of the business entirely. These men see no public good to be derived from the reserves when grazing privileges are denied. Their permanent ranches are so distant from the high mountain watersheds that the idea of protecting water supplies is looked upon as visionary or impractical. Moreover, the fact that snow remains longer on the high, bare mountain peaks than it does in the forest below proves to these men conclusively that forests have no influence in conserving water. The general feeling is that in reserving forest land the National Government has no sympathy with the settlers, some of whom say that they shall have to leave the country if this policy continues.

Most other settlers also, not directly interested in grazing, voice the protests of stock raisers. The feeling against forest reserves expressed by settlers along the Carson Valley toll road was very bitter. However, the sheepmen pay large tolls in "driving" through this region.

CLASSIFICATION OF LANDS

INCLUDING

PAPERS BY C. H. FITCH, R. B. MARSHALL, E. C. BARNARD, AND JOHN B. LEIBERG

BY

HENRY GANNETT

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CLASSIFICATION OF LANDS.

By Henry Gannett and others.

SONORA QUADRANGLE, CALIFORNIA.

By C. H. Fitch.

This area, in the western foothill country of the Sierra Nevada, extends in altitude from 500 to 3,000 feet above sea level. Below 3,000 feet its irregular ridges are covered with chaparral of manzanita and chimisal brush and a scattering growth of digger pine and oaks. The Tuolumne and Merced rivers and their branches have cut deeply through the soft slate, forming canyons from 1,000 to 2,000 feet deep. In ordinary seasons the amount of snow which falls upon the mountains at the sources of the rivers causes an abundant flow of water in the streams during the dry season of the summer and fall, but in 1899, owing to the lack of snowfall the winter before, the customary supply for the use of the mines fell short early in the season. In midsummer vegetation is dry and parched and apparently burned and dead until the winter rains come again to revive it. The heat is intense and continues uninterruptedly through the long summer. The soil forms dust so light as to be lifted with the slightest breeze, and even away from the roads and trails this powder covers every leaf and rock.

The Mother Lode, as the great gold belt of California is known, crosses the Sonora quadrangle from northwest to southeast. In the early days of California the placer diggings in this region brought throngs of miners, and mining camps were established everywhere, as is shown to-day by the washed-out gulches, the heaps of uncovered rocks and bowlders, and the many almost deserted towns. All of the gold that could be obtained by the process of washing was taken out in a short time, and then a period of inactivity existed for over thirty years. Of late mining has been revived, the gold now being sought for in the quartz. Some of the old towns have become active once more and new ones are springing up.

There is but one railroad, the Sierra Railway, a short line extending from Oakdale, a station on the Southern Pacific, to Sonora, the county seat of Tuolumne County, a town of about 2,500 inhabitants. This road is now being extended, and will probably soon be running to Carter, about 10 miles east of Sonora. From Carter a narrow-gage railroad is projected northeastwardly for about 15 miles into timber lands. Over every part of this area crops are cultivated, but this cultivation is due to the demand of the mines and the mining towns for supplies in the way of hay, grain, and vegetables, as well as dairy products. Without the mines agriculture would not be considered profitable in a country so rough and difficult to work. As it is, but small areas are used for agricultural purposes, and although farms are numerous the extent of the cultivated land of each is small. No extensive irrigation system is used, but each farm is independently irrigated from small streams or springs, and the largest portion under cultivation produces hay without irrigation. In the extreme southwestern portion of the area land is irrigated from the Merced River, and here an extensive irrigation system is commenced at Merced Falls, which is about 10 miles from the western edge of the quadrangle. For this distance, in a belt having an average width of 2 miles, are most productive and well-cultivated farms under ditches. In an area extending northward from this valley for about 5 miles, land is cultivated for hay without irrigation, and it is possible that portions of this land could be irrigated, although to take water upon it would be attended with large expense.

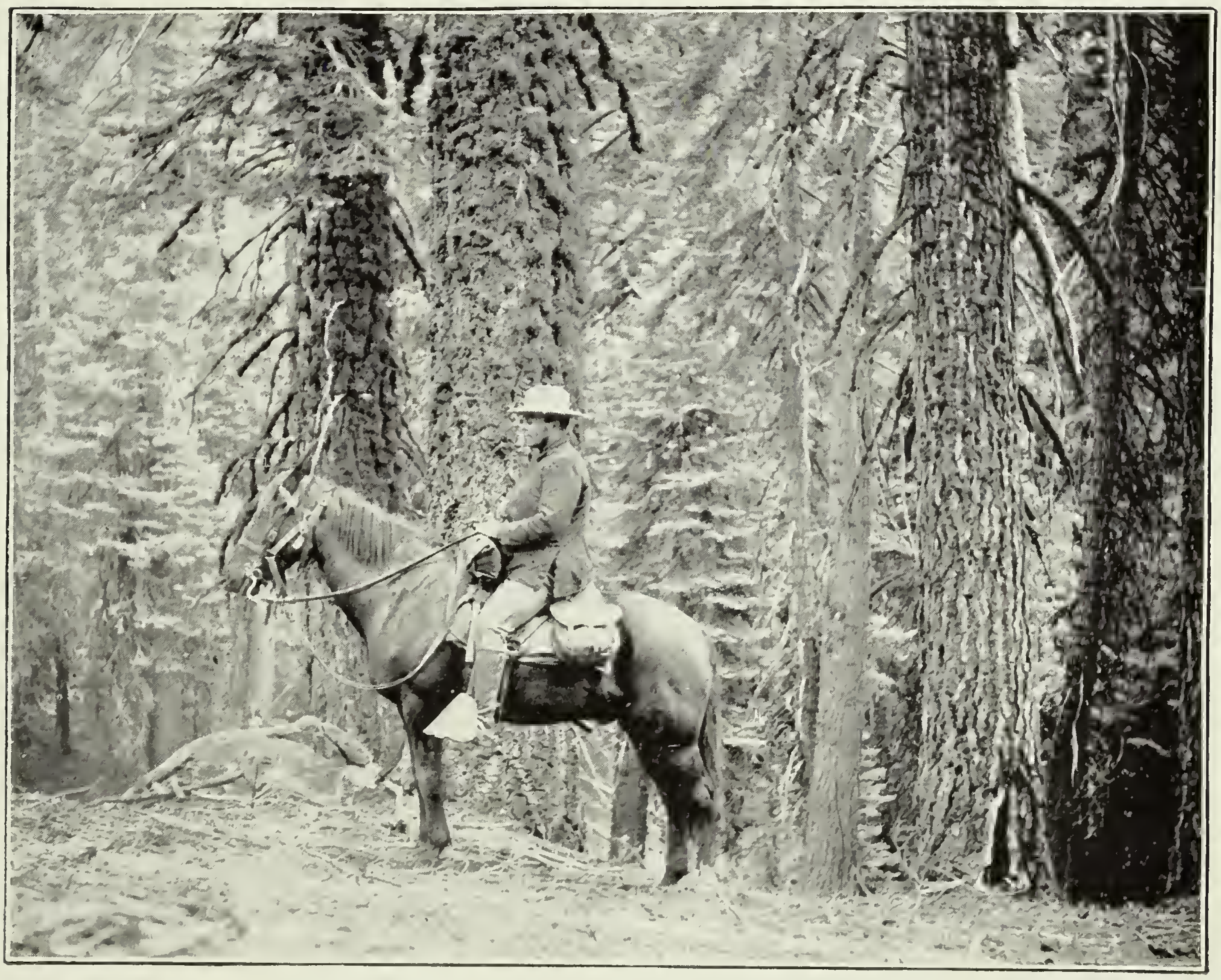
Another extensive system of irrigation is carried on in the Tuolumne Valley, the water being obtained from the Tuolumne River at a large dam just above Lagrange, but no use can be made of it until after it leaves the quadrangle.

With the exception of the southwestern portion, just described, almost the entire area of this quadrangle is woodland or covered with brush. The timber, consisting of digger pine and oak, is suitable only for fence posts, fuel, and similar purposes. As the altitude increases, however, mill timber is found, and at an height of 3,000 feet and over the stand of sugar pine and yellow pine is of some value, but not of much importance in this quadrangle, except in the northeast corner, where the stand will probably reach 30,000 feet B. M. per acre. Most of the mine timbers and lumber used in and about Sonora come from the forest just north of this quadrangle, where extensive lumbering operations are being carried on.

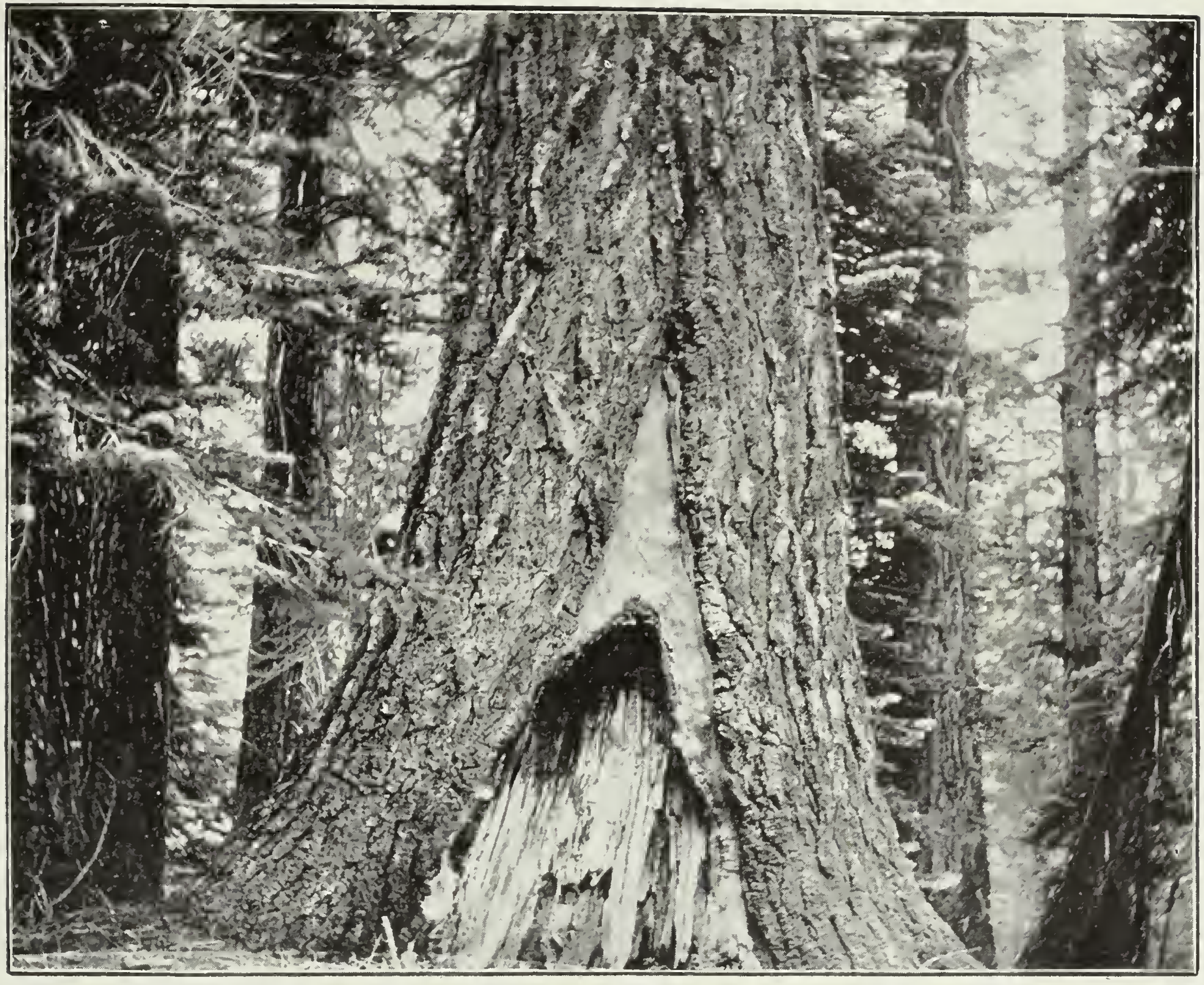
Animals are grazed in nearly all parts of the area, but no portion would be considered good pasture land or of more value for that purpose than any other.

Taken as a whole, the Sonora quadrangle is a difficult area to classify in detail, for although much land is utilized for agriculture, with and without irrigation, and for pasturage, it is neither agricultural nor pastural, and the areas cultivated are, as a rule, too small to be shown upon the scale of the map.

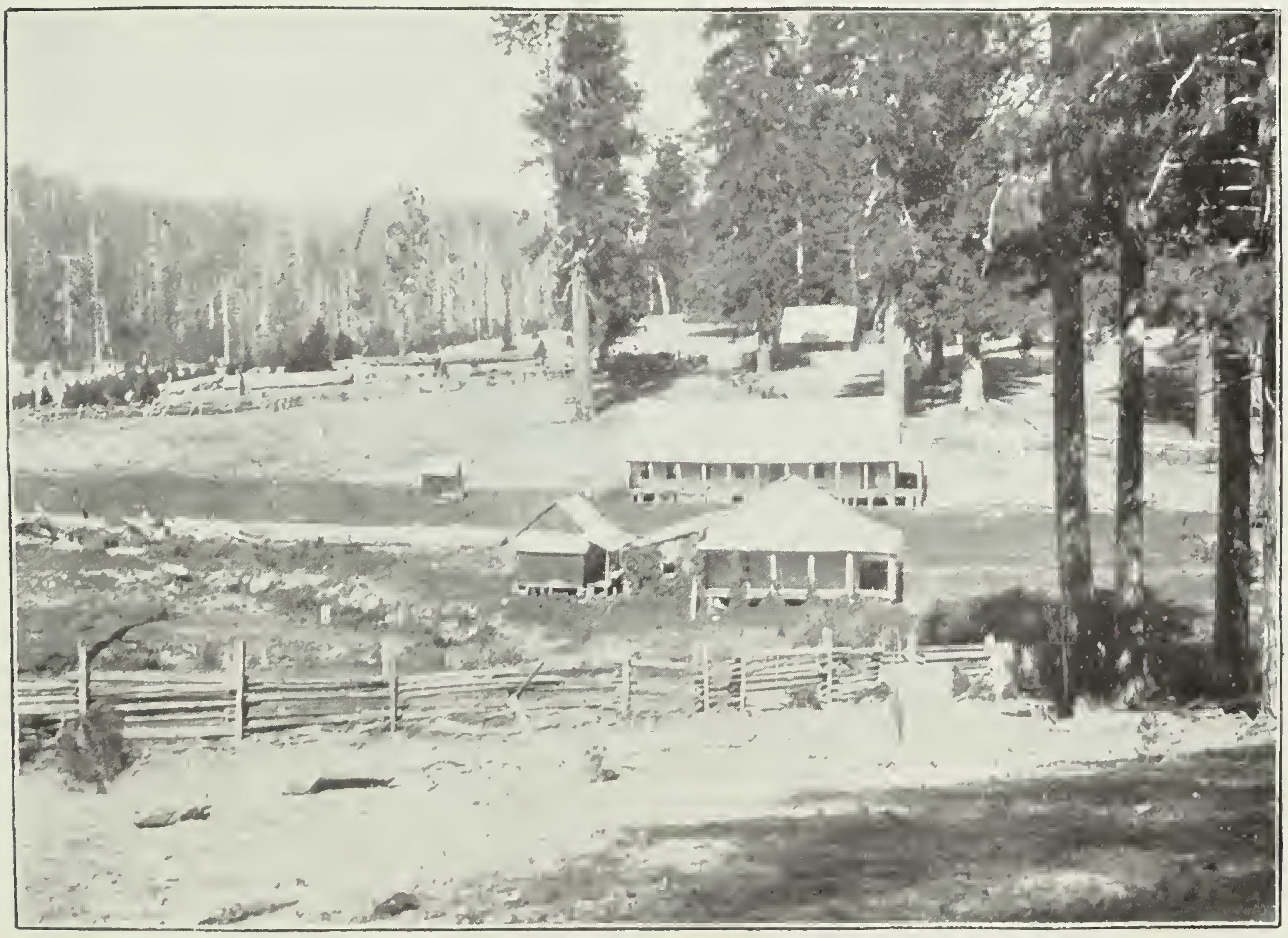
A, OAKS IN FOOTHILLS.



B. ABIES MAGNIFICA, YOSEMITE NATIONAL PARK.



A. ABIES MAGNIFICA, SHOWING EFFECTS OF FIRE, YOSEMITE NATIONAL PARK.



B. MOUNTAIN MEADOW, YOSEMITE NATIONAL PARK.

The classification of lands in the Sonora quadrangle, as shown on the accompanying map (Pl. CXV, in atlas), is as follows:

Land classification in Sonora quadrangle, California.

	Square miles.
25,000–50,000 feet of timber per acre	1.50
10,000–25,000 feet of timber per acre	58.50
5,000–10,000 feet of timber per acre	77.00
Brush and scattering timber	649.50
Pasture	99.00
Cultivated, not irrigated	53.00
Cultivated, irrigated	15.50

Total stand of timber in quadrangle, 1,000 million feet.

YOSEMITE QUADRANGLE, CALIFORNIA.

By C. H. Fitch.

The Yosemite quadrangle lies just east of the Sonora quadrangle and extends from the foothills to the high mountains. The altitude along its western edge is about 3,000 feet, and near its eastern limit Mount Hoffmann reaches an altitude of nearly 11,000 feet. The forest, which is a magnificent one, covers nearly the entire area, the middle section extending from the northwest corner to the southeast corner, with an average elevation of 5,500 feet, being covered with the heaviest growth and most valuable timber. The principal trees of economic value are the yellow pine, sugar pine, and red fir. The incense cedar, white fir, silver fir, two-leaved or white-bark pine, and numerous other species are also found. Digger pine grows on the lower limits, and oaks, both white and black, and mountain live oak are found scattered along the brushy ridges and southern slopes. The undergrowth consists largely of manzanita, but many varieties of bushes, including chinquapin, dogwood, laurel, maple, hazel, etc., were noted. The forest is remarkably free from undergrowth, however, and only along streams, in the bottom of gulches, and on rocky southern slopes is the brush so thick as to impede progress. The sugar pine, the white pine of California, and the yellow pine are magnificent trees and reach great size in this forest, many of them exceeding 200 feet in height and 7 feet in diameter. As many as nineteen sugar pines averaging 50 inches in diameter and 70 feet in length from the ground to the first limb were counted upon a single half acre. The red fir also attains good size and is quite abundant, its range extending to a higher elevation than the pines mentioned and growing nearly as low. The incense cedar grows over a wide range, mingled with the pines and firs, and is a large tree. The white and silver fir are beautifully symmetrical trees of smaller size than the red fir, their range extending from about 5,000 to 9,000 feet. The tamarack, or two-leaved pine, is one of the high-altitude trees found with aspen in the canyons and gulches and with the firs on the divides and on the high, rugged slopes of the Sierras nearly to timber line. At about 7,000 feet elevation it is a good-sized tree of 12 or 15 inches diameter and corresponding height, but at its greatest altitude it is a low, contorted, and brushy-topped bush.

The trees of commercial value grow best between the altitudes of 4,500 and 6,500 feet, and, except on the bare granite slopes, the mountain meadows, and some of the southern slopes, the stand of timber is good. In selected areas where measurements were made the stand will run from 80,000 to 140,000 feet B. M. per acre. An average for the timbered areas of this quadrangle may be stated as ranging from 30,000 to 40,000 feet B. M. per acre.

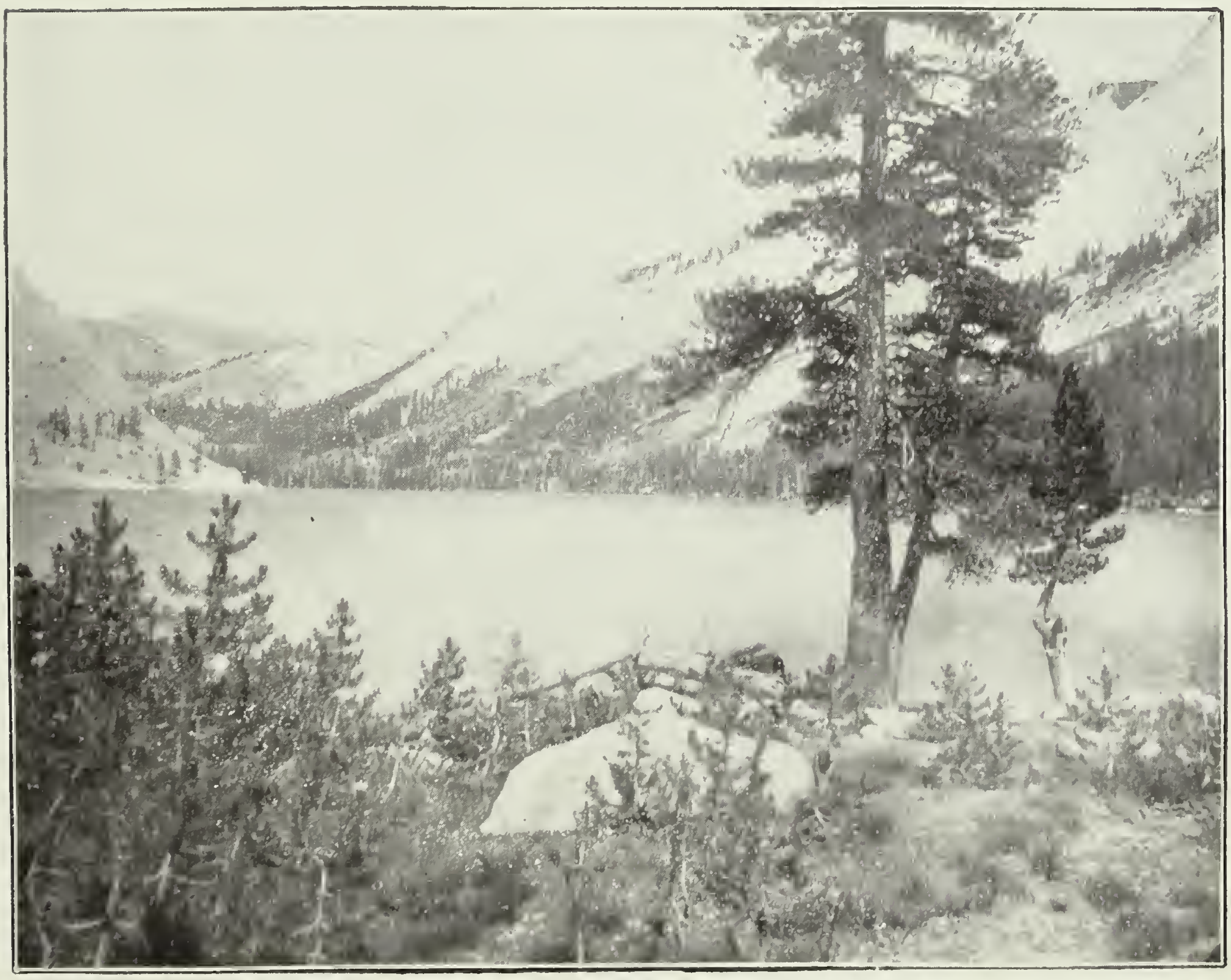
Nearly all of the Yosemite quadrangle is included within the boundaries of the Yosemite National Park. Protection is given the timber against fires, although several were noted during the past summer, and one continuing for several weeks burned over a large area. No particular damage was caused, however, to the larger timber with the exception of cedar and fir trees in certain localities, the sugar and yellow pine generally appearing to escape unhurt, although a great amount of dead and fallen timber had accumulated upon the ground. Some of the timber land was owned by private individuals before the park was created, but no cutting is being done on any part of the quadrangle at this time.

The high mountain slopes, the numerous mountain meadows, and the river valleys, as well as the open timber, have in years past afforded excellent pasturage for sheep and cattle, but under existing park regulations for the protection of timber no grazing is allowed except upon private property under fence. It is not possible to delimit upon the map the exact areas which may be classed as pasture land for the reason that much of the grazing land is also wooded.

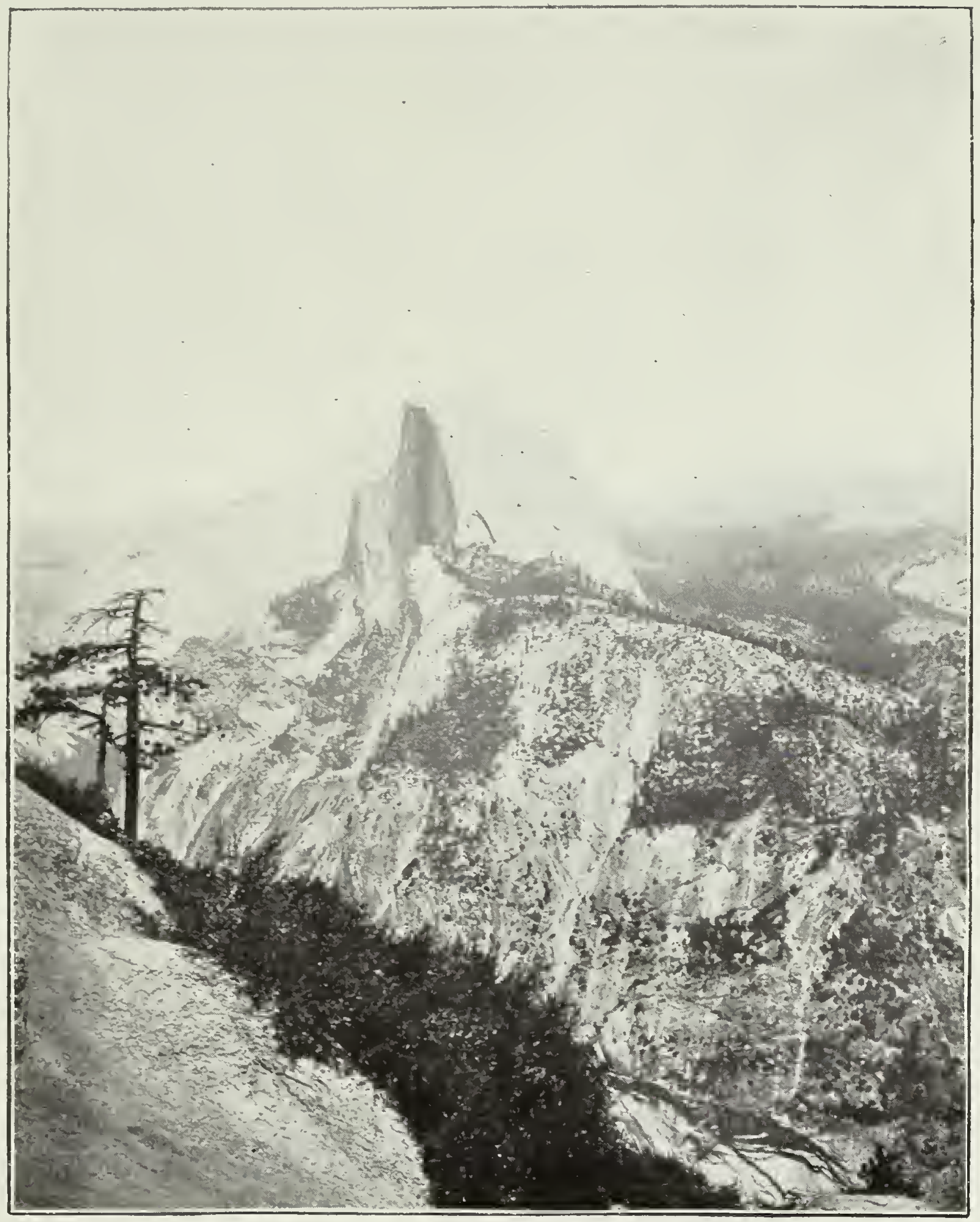
There is practically no cultivation of the soil upon the Yosemite quadrangle, although there are a few gardens and orchards and small plots of land cultivated for hay and barley, but the total acreage of such occupation amounts to but little. This is accounted for by the fact that the land is not open to settlement and there are but few private holdings, also because the general elevation is too great and the summer season too short to permit cultivation except for a few products.

Three groves of big trees (*Sequoia gigantea*) are located in the Yosemite quadrangle. The Merced grove, containing about twenty-five trees, is situated just west of the middle of the quadrangle, in Mariposa County, near its northern boundary. The Tuolumne grove, numbering about forty trees, is about 3 miles northwest of the Merced grove, in Tuolumne County. These two groves are similarly situ-

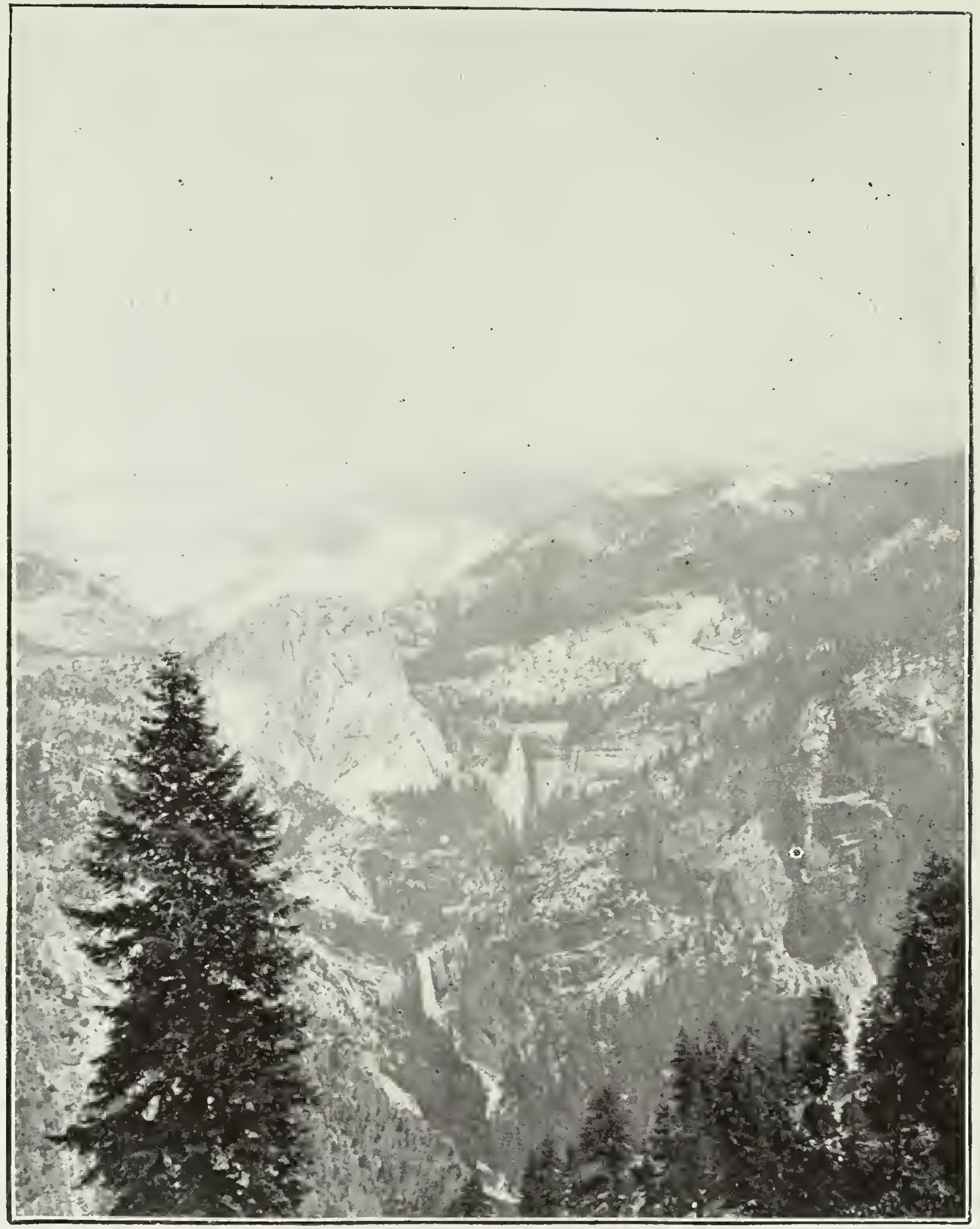
A. WAWONA, CALIFORNIA.



B. TENAYA LAKE, YOSEMITE NATIONAL PARK.



A. HALF DOME, YOSEMITE NATIONAL PARK



B. LOOKING TOWARD NEVADA FALLS AND VERNAL FALLS, FROM GLACIER POINT, YOSEMITE NATIONAL PARK.

ated in gulches and at about the same elevation (5,500 feet) above sea level. The sequoias are growing in a heavy forest of sugar and yellow pine and red fir, with much undergrowth, and are long past their prime, and look what they are—badly scarred veterans, damaged by fires and shaken by winds, the effects of which are seen in the destruction of the thick bark, numerous hollows burned into the trees at the ground, and the broken tops. Several of the trees are but dead stumps, through one of which a wagon tunnel has been cut. The Mariposa grove is located on the southern edge of the quadrangle and is included in a tract of land granted by the United States to the State of California. These trees, numbering about six hundred and twenty, are divided into two groups, known as the upper and lower groves, which range in altitude from 5,400 to 7,000 feet above sea level. The upper grove is so situated as to show the sequoias to the best advantage, being on high, gently sloping, or nearly level open ground free from undergrowth. There are many trees in good condition, although here, as in the other groves, many show the effects of time, fire, and wind. The lower grove is on a southwestern slope a short distance from the upper grove, and is partly in a gulch, the sequoias growing with numerous other species of trees and brush. The ground here contains more moisture than in the upper grove, which may account for the number of young seedlings and saplings found here. In fact, sequoias of all ages are to be found in the Mariposa grove, many of them thrifty trees, numbering from 1 to over 30 feet in diameter and nearly 300 feet in height. A number of individual trees would each cut 100,000 feet of lumber. The sequoias often grow in pairs or groups of three or four close together, each group seemingly of about the same size and age. It is possible that, with the continuation of the protection against fire now afforded them, the sequoias may be able to perpetuate themselves, but from present appearances reproduction is not going on to any great extent, and it is quite probable that the species will eventually die out with the death of the great old time-worn and grizzled giants now standing.

The Yosemite Valley with its grand granite cliffs is a nearly level floor about 7 miles long by from one-half to three-fourths of a mile wide, which could easily be irrigated from the Merced River if desired, but as a State park its soil will probably never be cultivated to any extent. The Hetch Hetchy Valley, near the northern edge of the quadrangle, is somewhat similar to the Yosemite, but smaller, being about 4 miles long by one-half mile in width. It is also uncultivated.

The Yosemite National Park, with its varied topography, contains within its borders scenery of surpassing grandeur and beauty. Its mountain streams, lakes, cascades, and remarkably high waterfalls, deep canyons and gorges, perpendicular granite walls, cliffs and domes, magnificent coniferous forests and big trees, have a world-wide reputation which brings to it thousands of tourists annually.

The classification of lands in the Yosemite quadrangle, as shown in the accompanying sheet, is as follows:

Land classification in the Yosemite quadrangle, California.

	Square miles.
25,000–50,000 feet of timber per acre	284.25
10,000–25,000 feet of timber per acre	234.50
5,000–10,000 feet of timber per acre	277.50
Brush and scattering timber	150.75
Pasture	6.75
Cultivated, not irrigated	.25

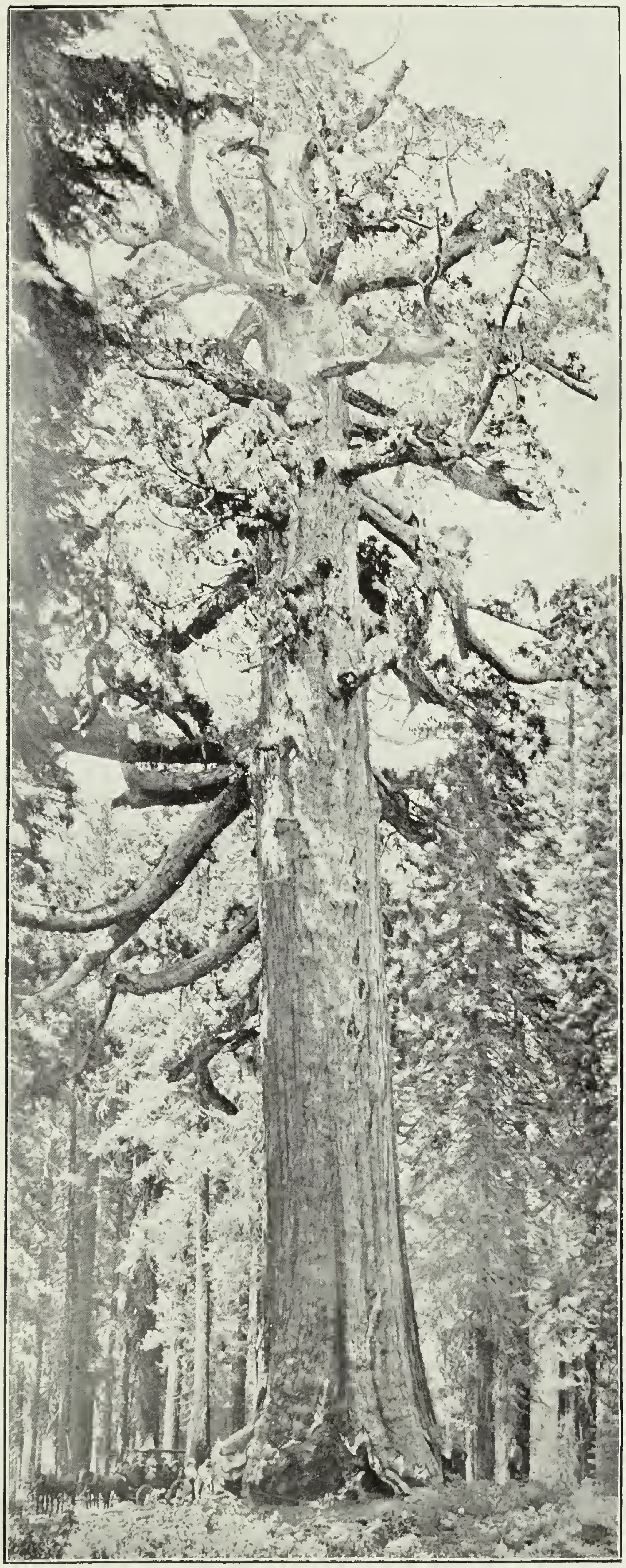
Total stand about 10 billion feet.

MOUNT LYELL QUADRANGLE, CALIFORNIA.

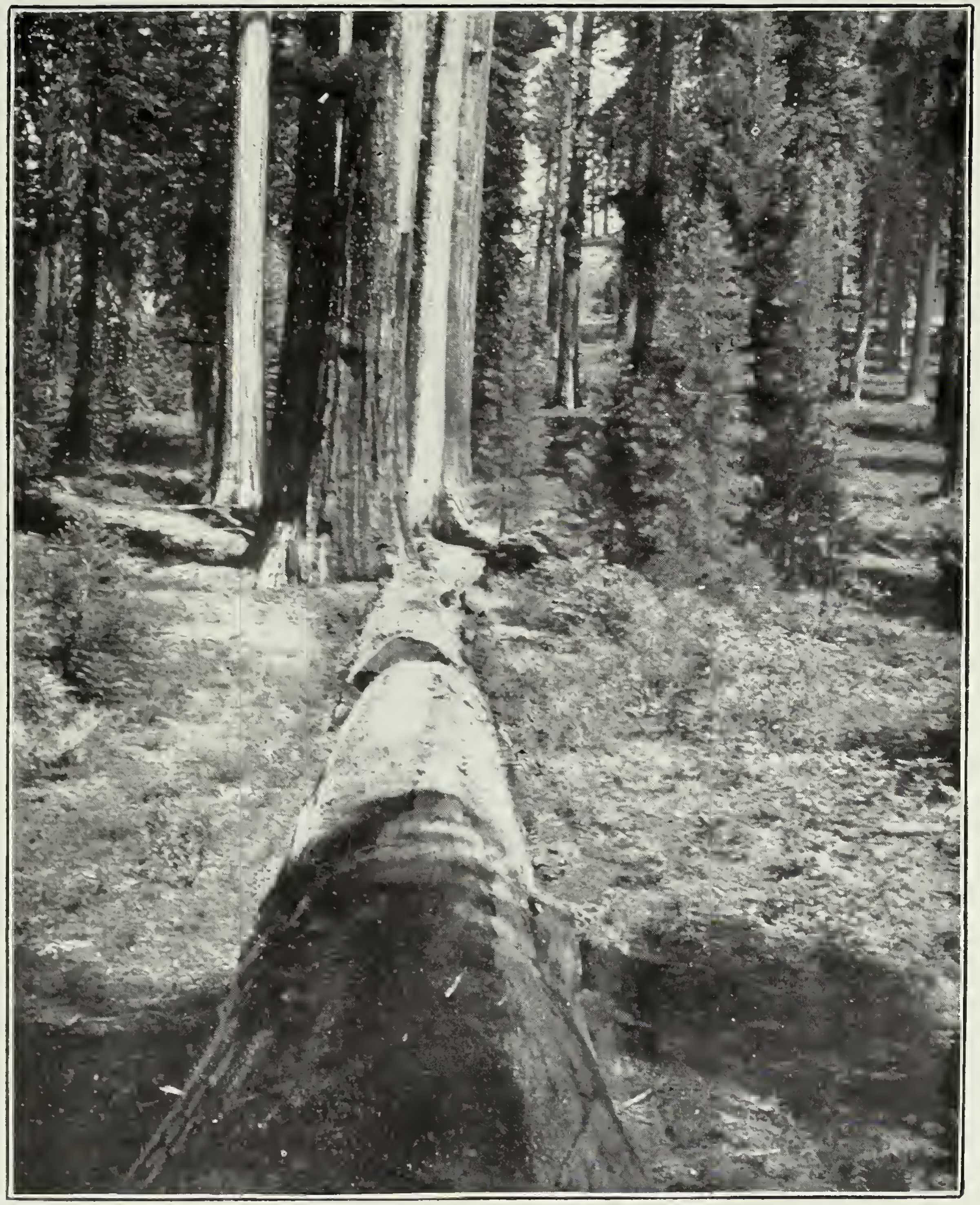
By R. B. Marshall.

This quadrangle is situated in eastern California, its boundaries being parallels 38° and 38° 30′, and meridians 119° and 119° 30′. Entering from the north and crossing the quadrangle in a southeast direction extends the summit of the Sierra Nevada; about two-thirds of the area being on the western and one-third on the eastern slope of the range. Much of the area, nearly one-half, is above timber line, alpine in character, devoid of timber, grass, or soil. The rocks composing the peaks are generally granite, slate, or volcanic. The elevation above sea level extends from 4,500 to 13,156 feet, the latter being the elevation of Mount Ritter. The headwaters of the Tuolumne, Merced, San Joaquin, and Owens rivers, numerous small lakes, and a portion of Mono Lake in the northeast corner are within the area. The rivers and their branches are confined within deep, rocky canyons containing many falls.

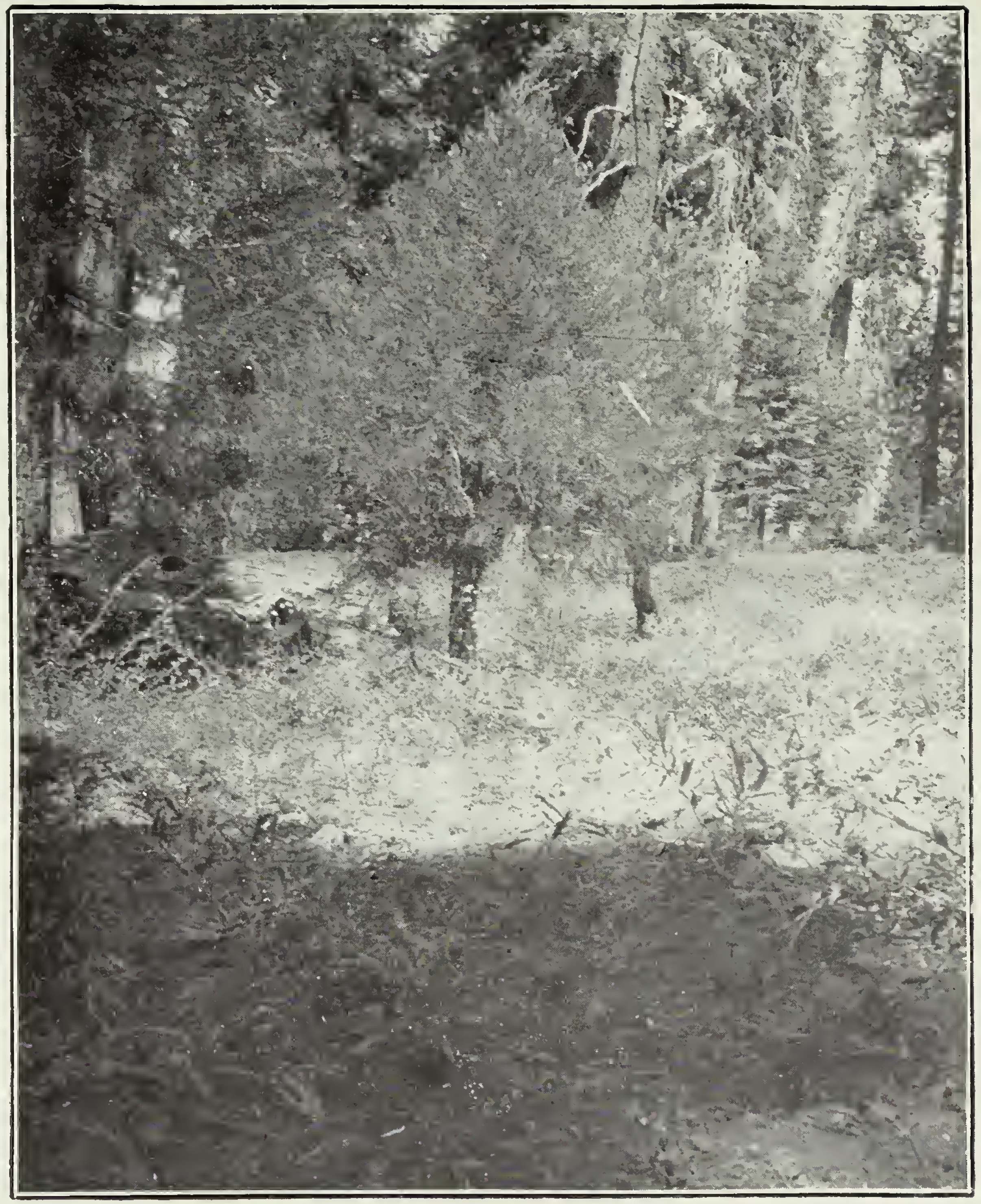
The areas of heavily timbered forest are scattered, and are confined to mountain slopes between 7,000 and 9,500 feet in elevation, although not all portions between these elevations are timbered because of lack of soil. The forest consists of red fir about 50 per cent, yellow pine about 22 per cent, sugar pine about 18 per cent, the remainder being white fir, white-bark pine, cedar, and spruce. One-third, or about 314 square miles, contains merchantable timber of the above species. One-fifth, or 128 square miles, contains scattering timber fit only for fuel, fence posts, etc. The largest portion of merchantable timber is on the western slope and consists mainly of red fir and sugar pine; that on the eastern slope is almost entirely yellow pine mixed with fir. The stand of timber of the forest-covered areas will average 20,000 feet B. M. per acre, while some of the sugar pine forest will run over 40,000 feet B. M. per acre. The forest is everywhere open without undergrowth of any kind. In certain localities areas of 4 or 5 acres contain



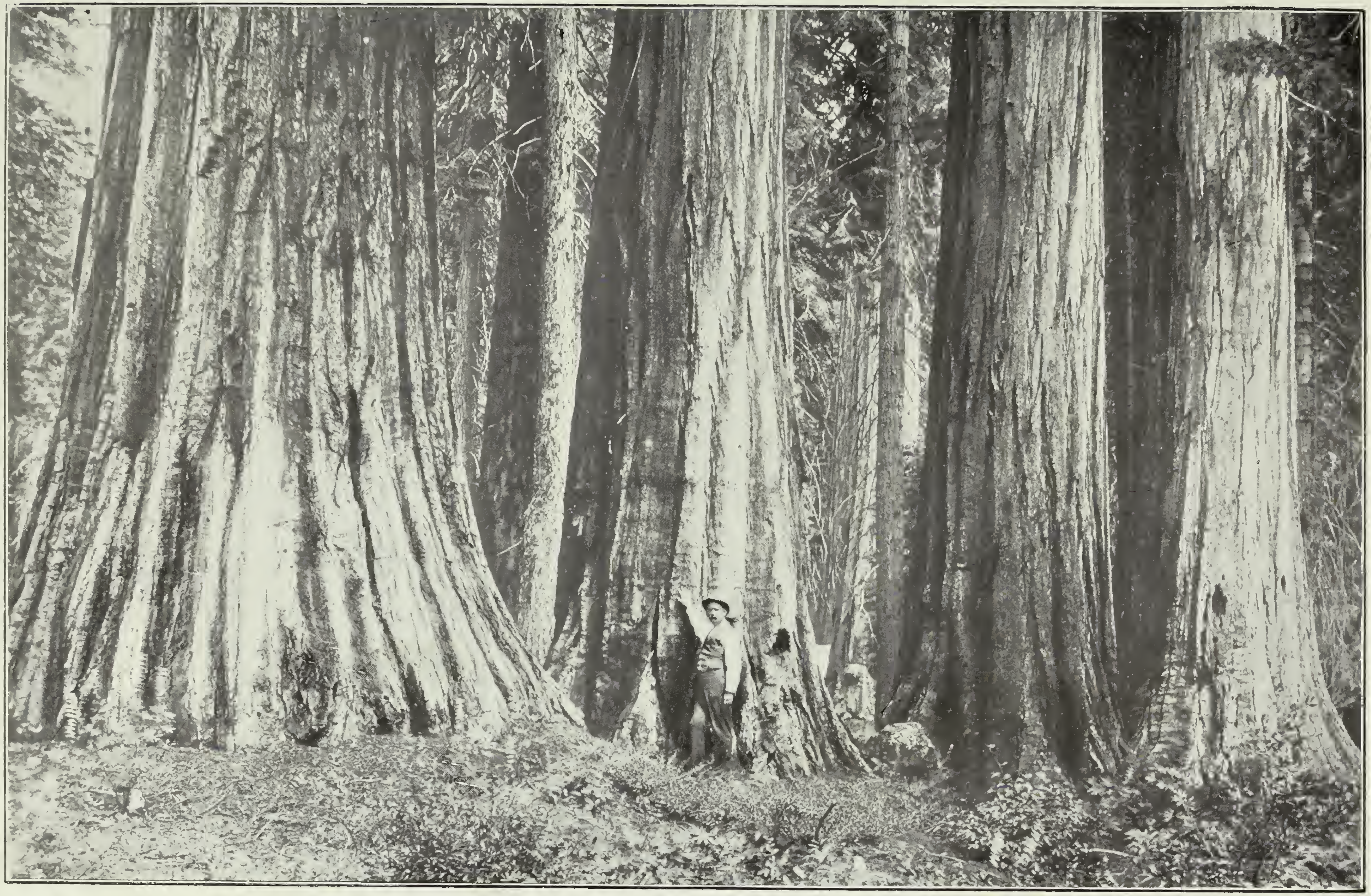
SEQUOIA GIGANTEA, "GRIZZLY GIANT," MARIPOSA GROVE.



A. SEQUOIA GIGANTEA OF NEARLY ALL AGES, MARIPOSA GROVE.



B. YOUNG SEQUOIA GIGANTEA, MARIPOSA GROVE.



GROUP OF SEQUOIA GIGANTEA. MARIPOSA GROVE, CALIFORNIA.

standing dead timber, every tree having been killed apparently by some insect. No portion of the forest has been burned or logged. There is a sawmill about a mile south of Walker Lake, but the amount of lumber produced by it has not as yet affected the standing timber to any extent. Much of Mono Lake Basin is covered with lava flow which forms a surface unfit for cultivation, but there are fertile spots which will produce crops of hay, grain, and vegetables with the aid of irrigation. There are a number of small areas so cultivated. The lands which produce grass fit for pasture are well scattered, but where soil is found there is generally a luxuriant growth of grass. About two-thirds of the quadrangle is in the Yosemite National Park and about 70 square miles along the southern border are in the Sierra Forest Reserve. The total stand of timber on this quadrangle is estimated at 4,000 million feet B. M.

SAN JACINTO QUADRANGLE, CALIFORNIA.

This quadrangle is situated in the southern part of the State. It includes the pass utilized by the Southern Pacific Railroad between the San Bernardino Range on the north and the San Jacinto Range on the south, together with the vast main mountain group. This quadrangle stretches over a large timber country and rises in San Jacinto Peak to an altitude exceeding 11,000 feet.

The surrounding valleys are desert except where irrigated, and the amount of land redeemable from the desert is dependent upon the quantity of water available. Most of the unredeemed land, together with the lower slopes of the mountains, up to an altitude, broadly speaking, of 5,000 feet, is covered with a dense growth of chaparral, consisting of a dozen or more species of thorny plants, among which scrub oak and cat's claw are prominent.

Above 5,000 feet or thereabouts yellow-pine timber begins to appear among the chaparral, and gradually, as the altitude increases, the timber becomes more abundant and the chaparral disappears, so that above 6,000 feet the vegetation consists of open forests of yellow pine, interspersed here and there with sugar pine and with an occasional specimen of big cone or Coulter pine. The pine is of large size with a good clear trunk, and indeed all the area indicated as timbered, 175 square miles, is covered with timber of merchantable size and quality. A little of this timber in the southwestern part of the forest has been cut over an area covering altogether not more than 1 square mile.

Brush-covered areas, which may to all intents and purposes be considered absolutely barren, have an area of 679 square miles. There are several areas in the mountains where grass takes the place of chaparral and which may therefore be classed as grazing lands. These amount to 56 square miles.

The area which may be irrigated within this quadrangle has been estimated as possibly 71 square miles. As this, however, is dependent not only upon the amount of water available, but upon the economy of its distribution, it is to be accepted only as a provisional estimate.

PORT ORFORD QUADRANGLE, OREGON.

This quadrangle is situated in the southwestern part of the State, bordering on the Pacific Ocean and including a portion of the Coast Range, here very broken and irregular.

With the exception of numerous small patches of prairie scattered over its surface, it was formerly densely forested throughout, but a large proportion of the area has been burned over, destroying the forests, which are now in process of reproduction; hence with the exception of these prairie tracts and numerous little patches of land which are under cultivation, the entire area is wooded, although by no means all covered with merchantable forests. Out of a total land area of 853 square miles, 405 square miles, or nearly half, are still covered with forests of merchantable size and quality, with stands of timber ranging from 10,000 to 25,000 feet per acre, largely of fir and hemlock, with some spruce and cedar on the ridges near the coast. The burned area is 388 square miles, or nearly as much as is now forested. Over nearly all of this burned area, as was stated above, trees are growing and will in time become of merchantable size. Prairie land forms 39 square miles scattered in many small patches, and 13 square miles consisting of little patches scattered widely over the quadrangle are under cultivation. Small areas consisting of sandy stretches along the coast, estimated in the total amount at 6 square miles, are barren, and 2 square miles consist of marsh land.

The total stand of timber upon the timbered areas is estimated to be 3,888 million feet.

COOS BAY QUADRANGLE, OREGON.

By E. C. Barnard.

This quadrangle, comprising an area of 650 square miles, is in the southwestern part of the State, extending from the coast eastward into the Coast Ranges. It lies in a region of heavy rainfall, and was at one time nearly all covered with dense forests, but a large part of the timber has been removed by fire and the ax. Of its area of 650 square miles, 11 square miles consist of marsh, 166 square miles of open country, mainly in the bottoms of valleys which have apparently recently been drained, and in sand bars along the coast.

An area of 160 square miles has been partly burned, with a more or less complete destruction of the timber, and an area of 103 square miles has been cut, leaving only 210 square miles of standing merchantable timber. This ranges in stand from 10,000 to more than 50,000 feet B. M. per acre, the heaviest stands being near the coast, where the moist conditions are most favorable for heavy tree growth.

The total stand of timber upon this quadrangle is estimated at 4,774 million feet B. M. This is distributed among the different species represented as follows:

Stand of timber in Coos Bay quadrangle, Oregon.

Species.	Feet B. M.	Per cent.
Fir	3,530,000,000	74
White cedar	733,000,000	15
Red cedar	85,000,000	2
Spruce	426,000,000	9

ROSEBURG QUADRANGLE, OREGON.

By E. C. Barnard.

This quadrangle lies in the depression between the Coast and Cascade ranges of western Oregon and includes a portion of the foothills of the Cascade Range. The surface is broken with heavy spurs on the east coming down from the Cascade Range, broken hills in the middle and western parts, with narrow valleys along the Umpqua River and its forks. The valleys of the lower country are mainly prairie and the hills and mountains are densely forested.

The area of this quadrangle is 871 square miles. Of this 441 square miles are wooded, 263 square miles are under some form of cultivation, and 167 square miles consist of open country adapted to grazing.

Little of this area has been cleared, either for settlement or by lumbering operations. The cleared land consists entirely of land which originally was prairie. Lumbering has been carried on upon a small scale and mainly, if not entirely, to supply local needs.

The merchantable timber standing upon this area is estimated at 1,766 million feet B. M., nearly all of which is red fir. The average stand of timber upon the timbered area is about 10,000 feet B. M. per acre.

TACOMA QUADRANGLE, WASHINGTON.

The land-classification sheet representing this quadrangle shows the area which at the time of survey, in 1894–95, was covered with woods and the areas containing timber of merchantable size and quality, which, as defined by the practice in Washington, includes trees having a butt diameter of 20 inches or more, with a length below branches of at least 32 feet. It shows, furthermore, the portions of the quadrangle which have been cut over or culled for lumber or clearing and those which have been burned. As is seen, most of these areas have, since the cutting and burning, commenced to become reforested.

The areas naturally devoid of forests are also indicated, including a few square miles at the head of Commencement Bay, a small area in the valley of White River, and a large area south of Tacoma. The last is an area of approximately level land, covered by coarse glacial deposits in which the copious rainfall rapidly sinks, making it, to all intents and purposes, an arid soil. It is because of this feature of the soil that the region is largely open and park like. It contains scattered groves, largely composed of lodgepole pine, a species here of no merchantable value. The trees are of small size and branch nearly to the ground.

The total area of this quadrangle is 812 square miles. Of this the land area is approximately 737 square miles, the remainder being included in Puget Sound and a few small lakes. With the exception of the areas above mentioned which are naturally timberless or are covered with lodgepole pine, and which include about 105 square miles, the land area was formerly covered with forests of merchantable timber. Of this timbered area of 632 square miles, there have been cut or culled for lumber, or cleared for settlement, about 200 square miles, and there have been burned 143 square miles, leaving in standing merchantable timber only 289 square miles. Thus, since settlement began in this region, timber has been destroyed over an area of 343 square miles, or 54 per cent of the area formerly forested. On all the areas thus denuded timber is growing again, except where the land has been cultivated; so that the wooded area, including all lands on which wood is growing, comprises not less than 560 square miles, or 76 per cent of the land area of the quadrangle. The areas not now wooded consist not only of those naturally without forests, as above specified, but the sites and suburbs of the towns and cities and the numerous farms scattered over the quadrangle.

The area covered with merchantable timber is estimated to contain the following amount, in feet B. M.: Red fir (*Pseudotsuga taxifolia*), 1,686,900,000 feet; spruce (*Picea sitchensis*), 5,447,000 feet; cedar (*Thuja plicata*), 374,397,000 feet; hemlock (*Tsuga mertensiana*), 22,429,000 feet; total, 2,089,173,000 feet.

Four-fifths of the above amount of timber consists of red fir, and nearly all the remainder of cedar, the amount of spruce and hemlock being insignificant.

The average stand of timber upon the timbered area of this quadrangle is but little over 11,000 feet B. M. per acre, a stand only about half as great as that of the Seattle quadrangle, immediately north of it.

This region, lying in the valley of Puget Sound, at the head of that sheet of water, is blessed with an ample rainfall and a humid atmosphere, which are especially favorable to tree growth; so that wherever forests have been destroyed their reproduction is rapid, and the species which succeed are usually identical with those destroyed.

SEATTLE QUADRANGLE, WASHINGTON.

The land-classification sheet representing this quadrangle shows the area which at the time of survey, in 1894–95, was covered with woods and the area estimated to contain timber of merchantable size and quality, which, as defined by the practice in Washington, includes trees having a butt diameter of 20 inches or more, with a length below branches of at least 32 feet. It shows, furthermore, the portion of the quadrangle which has been cut over or culled for lumber or clearing and the area which has been burned. As is seen, most, if not all, of these areas have, since the cutting and burning, commenced to become reforested. The areas naturally devoid of forests are also indicated.

The total area of this quadrangle is 804 square miles. Of this the land area is estimated at 565 square miles, 239 square miles being occupied by Puget Sound and its arms and by Washington and Sammamish lakes and other small bodies of water.

This land area was formerly covered with forests of merchantable timber, with the exception of some 20 square miles of swamp lands in the valley of Snohomish River and at the head of Elliott Bay, near Seattle, which were naturally without forests. Of this timbered area of 545 square miles not less than 330 square miles have been cut or culled for lumber or cleared for settlement, and 40 square miles have been burned. Thus since settlement began in this region the timber has been destroyed on an area of 370 square miles, or two-thirds of the area formerly forested, leaving only 175 square miles in merchantable forests. On most of the land thus denuded timber is growing again, so that the wooded area, including all land on which wood is growing, comprises not less than 495 square miles, or 88 per cent of the entire land area. The areas not wooded consist of those naturally without forests, the sites and suburbs of the towns and cities, and the numerous little farms scattered over the quadrangle.

The area covered with merchantable timber is estimated to contain 1,653,246,000 feet B. M. of fir, almost entirely red fir (*Pseudotsuga taxifolia*), and 783,229,000 feet B. M. of cedar (mainly *Thuja plicata*), a total of 2,436,475,000 feet B. M. The merchantable timber consists almost entirely of these two species, and more than two-thirds of it is red fir. The average stand of timber upon this area is about 22,000 feet per acre, a heavy stand even for this heavily timbered part of the country.

This region, which is blessed with a heavy rainfall and a humid atmosphere, is especially favorable to tree growth, and wherever the forests have been destroyed the reproduction is rapid, and the species which succeed are usually identical with those destroyed.

MOUNT STUART QUADRANGLE, WASHINGTON.

This quadrangle lies upon the eastern slope and at the base of the Cascade Range in central Washington. The northern and western three-quarters of the quadrangle are mountainous and, in the main, wooded, while the southeastern corner is level and undulating and in large part cultivated, partly through irrigation and partly by dry farming. The mountainous portions of the area culminate in Mount Stuart, which has an altitude of 9,470 feet, this being far above timber line, which is here about 6,000 feet.

The wooded area of this quadrangle aggregates 579 square miles. All of this consists of merchantable timber, with the exception of about 25 square miles which has been cut and is now reforesting. The open country comprises 222 square miles. Of this, 39 square miles are rocky and barren, being the summits of the ridges and spurs of the Cascades in the northern part of the quadrangle. An area of 104 square miles, lying mainly in the valley of Yakima River and its tributaries, is under cultivation, and an area of 89 square miles consists of prairie land available for pasturage.

The timber consists mainly of yellow pine, with a slight admixture of red fir. The stand is very light, nowhere exceeding 2,000 feet B. M. per acre, and with an average over the timbered area of not more than one-half that amount. The total stand of timber is estimated at 370,560,000 feet.

ELLENSBURG QUADRANGLE, WASHINGTON.

This quadrangle, comprising an area of 816 square miles, lies upon the east slope of the Cascade Range, extending low down in the valley of Columbia River. It is drained mainly by the Yakima, Umptanum, Wenas, Naches, and Atanum rivers. The western part of the quadrangle is made up of heavy mountain spurs, diminishing in height toward the southeast, where the rivers have broad valleys. The climatic conditions are subhumid and much dry farming is done, although at some risk.

The cultivated areas aggregate 70 square miles, comprised mainly in the valleys of the streams; the pasture lands, 546 square miles; the barren areas, 10 square miles, and the wooded areas, 190 square miles. All this area was formerly covered with merchantable timber, but since white settlement began 68 square miles have been culled and the best of the merchantable timber has been taken out, leaving 122 square miles of merchantable timber.

The stand of timber is everywhere light, no areas containing more than 5,000 feet B. M. per acre, and ranging from this down to a scattering growth. It is an open forest with little underbrush, on an average of 80 per cent yellow pine and 20 per cent red fir. At the greater elevations—that is, near the western edge of the quadrangle—the proportion of fir is slightly increased, while lower down it is less. The total stand of timber upon this area is estimated at approximately 150 million feet B. M.

CHELAN QUADRANGLE, WASHINGTON.

This area of 805 square miles lies upon the eastern slope of the Cascade Range in northwestern Washington. The western half is composed of a rugged, mountainous country, mainly of granites, having a general eastward slope. In this mountain mass the streams have cut deep gorges, in some cases to thousands of feet. Lake Chelan, the southern end of which crosses the northeast corner of the quadrangle lies in a deep, narrow gorge, which, near the northern edge of the quadrangle, has a depth of 3,000 or 4,000 feet, but diminishes greatly in depth toward the outlet of the lake.

Columbia River crosses the southeastern part of the quadrangle in a narrow valley, with the ends of the mountain spurs upon the north and west, and the escarpment of a great basalt plateau, the Plains of the Columbia, upon the south and east.

The amount of cultivated land upon this quadrangle is trifling, being confined to a few garden patches in the narrow valley of the Columbia and near the foot of Lake Chelan, altogether not sufficient in extent to warrant representation upon the map.

The country east and south of Columbia River is grass covered, with the exception of one timber tract near the southern border of the quadrangle. The country to the west of the river, below its bend, is also grass covered, and contains a very scattering growth of timber for 2 or 3 miles back from the river. Above the bend the open country extends across to Lake Chelan and borders the lake on the north for a long distance above its foot; elsewhere the quadrangle is wooded and this wood is almost everywhere of size and quality suitable for building purposes. The area of pasture land on this quadrangle amounts to 328 square miles. The wooded area comprises 450 square miles, besides which three tracts, aggregating 6 square miles, have been burned. These areas, with that of Lake Chelan (21 square miles), make up the entire area of the quadrangle.

The timber consists throughout the quadrangle almost entirely of yellow pine, with only here and there on the north damp slopes a few red firs, while at the greatest elevations, as timber line is approached, subalpine species appear.

Over most of the timber area the timber is light and scattering, averaging less than 2,000 feet B. M. per acre, but toward the northern part of the quadrangle the timber becomes heavier and considerable areas are covered with a stand ranging from 5,000 to 10,000 feet B. M. per acre. The total stand upon the quadrangle is estimated to be 1,387 million feet B. M.

There has been no cutting in appreciable amounts within the limits of this quadrangle.

SPOKANE QUADRANGLE, WASHINGTON.

This quadrangle, comprising an area of 812 square miles, lies in eastern Washington, extending over the boundary slightly into Idaho. It includes the rapidly growing city of Spokane, situated at the falls of Spokane River in the western part of the quadrangle.

With the exception of the valley of Spokane River and a few smaller areas near it, this quadrangle was formerly covered with merchantable timber. The open country, much of which is under cultivation, affords good pasturage.

The timber areas are covered with a pure growth of yellow pine which south and southeast of Spokane has been culled for the use of the city. Much timber has also been taken out along the line of the Northern Pacific Railroad, and, to a less extent, along the Great Northern Railway north of Spokane. Elsewhere the forest remains intact. Like all yellow-pine forests it is open, with little or no underbrush. The trees are tall and straight with good clear height. The stand is light south of the valley of Spokane River and north of that valley for several miles, becoming heavier northward.

The total area of open country in this quadrangle is 174 square miles, of wooded land 626 square miles, of which 185 square miles have been culled of its valuable timber, leaving 441 square miles of merchantable timber still intact.

The total stand of timber upon this quadrangle is estimated at 500 million feet B. M.

SANDPOINT QUADRANGLE, IDAHO.

By John B. Leiberg.

TOPOGRAPHICAL FEATURES.

The area embraced in the Sandpoint quadrangle is situated in Kootenai County, Idaho, and contains approximately, 537,000 acres. Of this area 44,000 acres consist of lakes, streams, and permanent marsh, while 493,000 acres are mountain and valley land. The region is bisected by Pend Oreille River. This stream is the discharge for the waters flowing into Lake Pend Oreille, and is therefore in fact a continuation of Clark Fork of the Columbia.

The portion of the quadrangle north of Pend Oreille River is mostly a rocky and mountainous one. The mountain system consists of the southern terminations of two north-south divides which bound, on the east and west, a central basin constituting the valley of Priest River. The divide on the eastern side of the valley consists of a broad, massive granite axis rising in some places to elevations of 6,000 feet and flanked along its western foot by interrupted deposits of schistose rocks, while the steep and abrupt eastern slope sinks into a section of lacustrine plain stretching north from the western end of Lake Pend Oreille. The divide on the western side of the valley separates the Priest River Basin from the Pend Oreille Valley. It is composed of soft schistose rocks and is low, narrow, and broken. The valley of Priest River consists of a broad depression between the two divides, possibly of glacial origin. It has been smoothed and filled in with vast masses of glacial drift derived from the adjacent ridges and from the areas north of the quadrangle, out of which project numerous, small, detached ridges and elevations. Priest River has cut a narrow shallow channel through the drift, in some places to the bed rock, but mostly its bottom consists of the common bowlder drift of the region.

The tract of country situated south of Pend Oreille River is not so rocky and mountainous as the northern portion of the quadrangle. The mountain portion consists of detached or semidetached short ranges, ridges, peaks, and, in one or two instances, dome-like masses of rock, separated by low gravelly or marshy flats and levels of lacustrine and glacial origin. Not very far back in geologic times, when the waters of Lake Pend Oreille stood at a higher level than now, the flats were lake bottom. Later, when Pend Oreille River was dammed by the vast Priest River glacier, the discharge from the lake took a southward course across these flats and built them up to higher levels by the deposition of enormous masses of glacial drift. As the Priest River glacier slowly diminished in size the outflow cut narrow channels through the drift and formed the extensive and intricate system of low terraces, winding, dry, or marshy stream channels, and small lakes and ponds which now mark the surface of these flats. The mountains in this portion of the region are low, seldom rising above 5,000 feet. They are composed of granites, dolomites, limestone, and siliceous magnesian schists, with porphyry dikes here and there breaking through the schistose rocks. The intervening levels vary from 2,200 to 2,500 feet above sea level.

The chief stream of the region is Pend Oreille River. Between the point where it leaves Pend Oreille Lake and the mouth of Priest River the width of the stream varies from one-half to two-thirds of a mile. There is but little fall between the two points, and many stretches of nearly slack water. It is easily navigable for steamers of almost any draft. Below the mouth of Priest River the stream narrows to a width of 500 yards and the current becomes rapid. It ceases to be navigable a few miles below Priest River, at Albane Falls. The valley of the Pend Oreille, within the quadrangle, is narrow, with little bench land. Priest River is the outlet for Priest Lake. It is a small stream of no especial importance. The streams south of Pend Oreille River are mostly mere creeks. A few empty into Pend Oreille River. Most of them sink as soon as they reach the gravelly levels.

Ponds and marshes abound in the region south of Pend Oreille River. There are comparatively few in the northern areas. Cocolalla Lake is a shallow sheet of water; the southern end of Priest Lake is of similar nature, as are the numerous smaller lakes and ponds. The portion of Pend Oreille Lake north and south of the town of Sandpoint is comparatively shallow, probably not exceeding 100 feet in depth. The portion of this lake coming within the areas of the quadrangle in its southeast corner is of very great depth, probably exceeding 1,000 feet. Its shore is here bounded by a rampart of mountains 1,000 to 1,500 feet in height.

FOREST CONDITIONS.

The region is essentially a forested one throughout its entire extent. The only exceptions are clearings and tracts covered with brush as the result of fires. The great mass of the forest is composed of coniferous species. The broad-leafed trees, of which the principal species are cottonwood, aspen, thorn, service berry, willow, western and canoe birch, and dwarf maple, constitute less than 1 per cent of the forest. The coniferous growth is composed of the following species: Yellow pine (*Pinus ponderosa*), white pine (*Pinus monticola*), lodgepole pine (*Pinus murrayana*), white-bark pine (*Pinus albicaulis*), silver fir (*Abies grandis*), alpine fir (*Abies lasiocarpa*), red fir (*Pseudotsuga mucronata*), western larch (*Larix occidentalis*), Pacific arbor vitæ (*Thuja plicata*), Engelmann spruce (*Picea engelmanni*), western hemlock (*Tsuga mertensiana*), Pacific yew (*Taxus brevifolia*), and red juniper (*Juniperus virginiana*).

The coniferous forest occurs under four chief groupings or types. They are: The yellow-pine, red-fir, white-pine, and alpine-fir types. The white-pine and alpine-fir types are fairly well differentiated. The red-fir type is mostly a transition grouping from the yellow-pine to the white-pine type. There is, however, never an absolute line of demarcation between any of the types owing to the influences of soil moisture and slope exposure, which permit a free mingling of the different species to take place along their upper and lower limits, often far beyond their general altitudinal extensions and range.

YELLOW-PINE TYPE.

This type of forest exists on tracts where, by reason of low annual precipitation, drainage, lack of seepage, or other causes, the altitudinal factor is coupled with the lowest ratio of soil moisture throughout the year; hence usually below the 3,500-foot contour. It thus forms the lowest zone of forest in the region. Assuming 10 as representing complete, permanent saturation of the soil, we may say that the yellow-pine type requires a soil-moisture ratio varying from 1.1 to 2.

In the Sandpoint quadrangle the yellow-pine type covers an area of 60,000 acres. Most of it occurs on the areas south of Pend Oreille River, where it forms an irregular but fairly connected body of timber on the gravelly flats between the different ranges of mountains. North of Pend Oreille River the stands of the type are more scattered, and generally occur as small detached bodies on the dry and warm southern slopes of the mountains bordering the river. Thin and interrupted stands of the type also extend northward along the valley of Priest River and on the eastern slopes of the divide between Priest and Pack rivers.

As here limited the yellow-pine type consists of stands in which the yellow pine predominates in volume to the extent of 55 per cent and upward, the balance of the stands being composed of varying percentages of lodgepole pine and red and white or silver firs. The percentages of species other than the yellow pine depend largely on the age of the different stands, or on the length of time that has passed since the last great fire, or on the number and frequency of the numerous smaller and local fires which ravage the region almost every year. In stands composed chiefly of standards and veterans typical ratios of the different species are as follows:

Species constituting the yellow-pine type in the Sandpoint quadrangle, Idaho.

	Per cent.
Yellow pine	75
Lodgepole pine	10
Silver fir	8
Red fir	7

On areas where the soil-moisture ratio falls to the lowest proportion consistent with the growth of the type the percentage of yellow pine may reach 90 per cent, as it frequently does, which results in an almost complete obliteration of the red-fir and silver-fir components, while on tracts having a soil-moisture ratio as high as is compatible with the existence of the type, red fir and silver fir become abundant enough to lower the yellow-pine ratio to 50 or 55 per cent. Throughout all of the area covered with the type the universal rule is that the percentage of yellow pine is strictly proportioned to soil moisture and that a rise in this factor beyond a certain point results in increased percentages of silver fir and red fir, with a corresponding elimination of the yellow pine. Pure stands of the type are rare in this region. When they occur they are limited in extent to areas containing 20 to 300 acres and are situated on slopes where rapidity of drainage counteracts the effects of precipitation and elevation, both of which factors are too high in this region to permit a very extensive development of a pure type.

The aspect of the type varies from open and park-like stands to those of medium density. Stands composed of veterans or well-advanced standards present the open aspect; stands composed of young or middle-aged standards or saplings are more thickly set; sometimes, as in reforestations after fire, the young growth becomes excessively dense. In the park-like stands of the type the trees stand well apart and admit plenty of light to the ground. There may be a scattered growth of low shrubs, or, as is most generally the case, the forest floor is covered with a moderately close sward of grass and sedge. The type rarely assumes this open aspect short of one hundred and seventy-five years of fairly uninterrupted growth. In stands of younger and more close-set growth the forest floor is either bare or covered with seedling trees or with low suffrutescent or herbaceous vegetation other than grass or sedge. There is a light covering of humus 2 to 3 inches in depth, and often considerable litter consisting of broken and decaying trees.

During the past forty years forest fires have overrun the entire area covered with stands of the type. Owing to the fire-resisting quality of the yellow pine the damage, while considerable, has not been so great or extensive as in the white-pine type for example. Still the destruction has involved a good deal of timber. At the present time the average stand of mill timber in dimensions within the local customary cutting practice is, for the entire region, 5,000 feet B. M. per acre, but the average capacity under natural conditions of growth, average soil and soil moisture, and freedom from fires is at least 15,000 feet B. M. per acre for veteran and well-advanced standard stands. The difference represents the loss from fire during the past 100 or 120 years and the logging operations within the last 15 or 20 years. Of the two factors the former is very much the larger.

The yellow-pine type is of considerable economic importance in this region. Owing to its accessibility fully 90 per cent of all the mill timber sawed or exported from the region is cut in stands of the type. The cutting is mostly confined to the yellow-pine species, the red fir, as it occurs on these tracts, being commonly of too small dimensions to be utilized for mill timber.

The yellow pine is of slow growth in this region. Little of it is suitable for saw timber short of 100 years of age. For the production of the clearer and better grades 150 to 200 years are required. Most of the land producing forest of the yellow-pine type is also suitable for tillage. The exceptions are the steeper slopes. Owing to this and to the fact that the high taxation which prevails in Kootenai County is practically prohibitive to private sylviculture on yellow-pine areas the tracts bearing this kind of forest are here rapidly passing out of existence.

RED-FIR TYPE.

This type occurs on areas below the 4,000-foot contour line. So far as regards altitudinal limitations it has practically the same range as the yellow-pine type. It requires a higher soil moisture ratio, the factors being 2 to 3.5. Owing to this circumstance the type is far more common than the yellow pine and covers a much larger area collectively.

In the region under consideration the type is found on about 100,000 acres. It is plentifully represented in all sections and there is no tract of any considerable extent that does not contain stands. It is relatively more abundant in the region south of the Pend Oreille River than north of this stream, constituting here almost one-half of the total forest growth, and occurring in bodies of as much as 20,000 acres. It is also widely distributed throughout the areas north of the Pend Oreille River, especially on the drier and rockier slopes in the white-pine areas in the Priest River Valley. In addition to this broad and general distribution, the type occurs in small scattered bodies of 20 to 100 acres throughout almost the entire extent of the areas covered with stands of the yellow-pine type, wherever the conditions of soil moisture permit its growth.

A larger number of species of trees enter into the composition of this type of forest than in that of the yellow pine. Hence its aspect differs much from that of the latter type, and its composition is generally more complex. Most of the coniferous species of the sylva of the region are represented in varying percentages throughout the stands of the type. The species lacking are: Alpine fir, white-bark pine, Engelmann spruce, and Pacific yew. The western hemlock also is mostly absent, but in occasional extensions of the type into that of the white pine a small percentage of this species may be present. In the composition of the type, where age has established a sort of normal or permanent balance between the various species, red fir constitutes the prevailing species. A typical example, where the soil is of first or second class as regards fertility and where moisture conditions are the average, has a composition as follows:

Species constituting red-fir type in first-class soil in Sandpoint quadrangle, Idaho.

	Per cent.
Red fir	65
White fir	20
Lodgepole pine	3
Western tamarack	10
Yellow pine, etc	2

Where seepage is above the average and the higher soil moisture ratios for the type prevail, there is usually a notable increase in the percentage of Western tamarack and a diminution in the quantity of red fir. An average composition for stands of the type in such localities is as follows:

Species constituting red-fir type where soil is above the average in Sandpoint quadrangle, Idaho.

	Per cent.
Red fir	40
White fir	25
Western tamarack	30
Lodgepole pine	4
Yellow pine, etc	1

On rocky and gravelly slopes, where the soil is thin and of little fertility, the type runs more to the red-fir component than elsewhere. In such situations red fir often prevails to the extent of 80 per cent, the balance being made up of silver fir and yellow pine.

The aspect of the type, where soil and moisture conditions are the best, is that of a forest above medium density. The trees are thickset, in the sapling and young standard growth varying from 1,000 to 3,000 trees per acre, while the 100 to 150 year old growths contain from 200 to 300 trees per acre. In such situations the trees grow tall, but do not develop large basal diameters, but a basal diameter of 20 inches, with a total height of 150 to 170 feet, is of frequent occurrence. In stands of the type growing on rocky or gravelly land, the aspect of the type is very often as open and park-like as in the yellow-pine type; more frequently, however, the trees stand well apart, but between them the ground is covered with dense masses of underbrush composed of species of ceanothus, opulaster, holodiscus, wild rose, and willow. The trees are short and stunted; they are of slow growth and almost always develop the crown portion disproportionately to the length of clear trunk. Litter is usually abundant, consisting of fallen trees which have died during the sapling stage, and prostrate and decaying trunks of an older forest which the present stands have replaced.

The red-fir type is of much economic importance in this region. Its value is not so much in the mill-timber factor as in the quantity of railroad cross-ties it is capable of yielding. During the past seventeen years the Northern Pacific Railroad has drawn an enormous quantity of tie material from this region, and nearly all of it has come from stands of the red-fir type. Most of the ties have been hewed ties, and, owing to the great height of the trees, coupled with comparatively narrow diameters of much of the growth, it was in just the right condition for purposes of tie timber. In consequence, it has been pretty thoroughly culled in all accessible localities within distances of 4 to 8 miles on either side of the railroad, and comparatively little with suitable dimensions for hewed ties is left. Red fir and western tamarack are the two species of the type that have been utilized for tie timber.

The volume of merchantable timber that stands of the type are capable of yielding depends on soil, exposure, and whether the estimates be based on mill-timber dimensions alone or on dimensions which also include tie timber. On rocky or thin-soiled slopes a large percentage of the type contains no mill timber whatever, running from 500 to 1,000 feet B. M. per acre in tie timber. Well-preserved stands on deep soil with plenty of seepage vary from 5,000 to 10,000 feet B. M. per acre in mill-timber dimensions, and from 12,000 to 40,000 feet B. M. per acre in mill- and tie-timber dimensions, collectively. A stand capable of yielding 40,000 feet B. M. in mill- and tie-timber may be regarded as exhibiting the ultimate capacity of the type. Previous to the beginning of tie cutting and to the extensive fires which have followed the settlements in the region the average stand of both classes of timber in the type south of Pend Oreille River may be assumed to have been about 18,000 feet B. M. per acre, and in the region north of this stream 8,000 feet B. M. per acre. At the present time the average stand throughout both sections is tolerably uniform and amounts to 4,000 feet B. M. per acre. The difference between the past and the present stands represents the cut and the wastage from fire during the past forty years, and of these two methods of forest extermination fire is responsible for 75 per cent.

About 80 per cent of the stands of the type are fire marked. The damage varies from a few trees or groups of trees burned here and there to total destruction. The region of greatest destruction is comprised in Ts. 54, 55, 56, and 57 N., Rs. 1, 2, and 3 W. Between fire and tie cutting most of the type has here been transformed into luxuriant brush growths. Reproduction of the type after fire usually involves a preliminary stage of brush or of lodgepole-pine growth, or a preponderance of silver fir in the composition of the seedling and the young sapling growth. Reproduction under normal conditions in stands where the preponderance of red fir has been firmly established is all toward a maintenance of the superiority of this species. Sometimes after a heavy and destructive fire the young seedling growth shows an abnormally large percentage of western tamarack, amounting to as much as 80 per cent, where previous to the fire there was not above 10 per cent of this species in the type. Reforestations of this kind depend on the configuration of the ground. They occur on the lower slopes and at the foot of declivities, where, owing to fires, the seepage from above is precipitated to the lowest levels in greater volume and with more rapidity than previous to the denudations of the upper areas of the slope. As there are no localities in the region where in stands of medium age the western tamarack component is present in such large percentages, it may be inferred that the condition mentioned exists only temporarily, while the upper portions of the particular slope are returning to forest cover.

Inroads of settlement and clearings are constantly diminishing the area covered with stands of the red-fir type. Most of its level or approximately level areas south of Pend Oreille River possess good soil and are valuable for purposes of agriculture, and under such circumstances owners of land bearing this type of forest can derive a much larger return from their investments by destroying the timber and putting the land under tillage. This is rapidly being done; the timber suitable for ties and mill timber is so utilized, the balance is either converted into fuel or burned on the ground where felled. In the course of a few years the type will, in this region, be restricted to the rocky and sterile slopes, where even under the most favorable circumstances it never develops any considerable quantity of commercially valuable timber.

WHITE-PINE TYPE.

This type of forest is more common and of greater extent than either of the two preceding types. Collectively, the tracts covered with stands of the type comprise 280,000 acres, or somewhat more than 50 per cent of the forested area in the district. Its altitudinal range lies between the 2,300- and the 5,200-foot contours, with its heaviest growths and purest development between the 3,500- and the 4,500-foot contours.

The type requires a high percentage of soil moisture. Its ratios in this respect vary from 3 to 6, assuming 10 as the saturation point. It flourishes best where the annual precipitation equals or exceeds 40 inches, but provided there be present the requisite soil moisture ratio the quantity of the yearly downfall matters little so long as it does not fall below 30 inches. The type therefore follows the margin of streams far into areas of red-fir type and in many places into tracts covered with stands of the yellow-pine type. North of the Pend Oreille

River it constitutes the bulk of the forest. It is especially plentiful in the Priest River Basin, and on the slopes and in the canyons of the divides inclosing this drainage. South of Pend Oreille River the type is less common and is much smaller in all of its proportions. Here it occurs mostly as fringes of heavy forest bordering marshes and streams and on the cold and wet northern slopes of a few of the more prominent elevations.

All of the coniferous species of trees in the region, with the exception of the white-bark pine, enter into the composition of the type. The yellow pine and alpine fir are but sparingly represented. For the former species the soil moisture ratio under which the type thrives is generally too high, and for the growth of the latter species the temperature conditions appear to be incompatible, except along the lower limits of the type. In the region north of Pend Oreille River the Engelmann spruce is common in the composition of the type, but on the areas south of this stream the spruce is present only in exceptional localities. Most of the type is composed of two species, namely, white pine and western tamarack. They prevail over all others, both in number of individuals and in volume. In the region south of Pend Oreille River the tamarack is the dominant species; on the areas north of the stream there is on the whole a nearly equal balance between the two species.

Owing to the wide range in soil moisture ratios of the type and to the large number of species composing it there is often a good deal of diversity in its composition. In wet ground, arbor vitæ, hemlock, and white pine form the chief elements of the stands. On drier ground western tamarack, white pine, silver fir, red fir, and lodgepole pine compose the forest. A representative stand of the type in the region north of Pend Oreille River, 250 years old and upward, is made up about as follows:

Species constituting white-pine type north of Pend Oreille River, Sandpoint quadrangle, Idaho.

	Per cent.
White pine	50
Western tamarack	45
Red fir Silver fir Pacific arbor vitæ	5

On the swampy areas in the Priest River drainage, in the Pack River Valley, and in the country south of Pend Oreille River, Pacific arbor vitæ frequently constitutes 50 per cent of the entire stand over small areas. On tracts carrying stands 100 to 120 years old the western hemlock sometimes prevails to the extent of 40 to 60 per cent, while on many of the burned-over areas in the Priest River drainage the sapling growth is 80 per cent western tamarack and less than 10 per cent white pine. A representative stand of the type south of Pend Oreille River, where even in the oldest growth the western tamarack is the dominant tree, has the following composition:

Species constituting white-pine type south of Pend Oreille River, Sandpoint quadrangle, Idaho.

	Per cent.
White pine	15
Western tamarack	60
Silver fir	10
Red fir	14
Pacific arbor vitæ	1

With the exception of certain circumscribed localities in the Priest River Valley carrying unusually heavy growths of white pine, none of the stands of the type long maintain any particular composition, and the examples mentioned apply only to areas of limited acreage. Taking the type throughout the quadrangle as a whole I would place its composition as follows:

Average composition of white-pine type throughout Sandpoint quadrangle, Idaho.

	Per cent.
White pine	17
Yellow pine	less than 1
Lodgepole pine	6
Western tamarack	50
Silver fir	12
Red fir	8
Pacific arbor vitæ	5
Western hemlock	1
Engelmann spruce Alpine fir	.5

The stands of the type where good soil and moisture conditions are present form forests of great density, somewhat comparable with the red-fir growths on the western slopes of the Cascades in this latitude. Seedling and sapling growths are usually exceedingly thickset. Two or three years after a fire I have counted the seedlings in the ensuing reforestation at the rate of 450,000 per acre, and in localities developing nearly pure stands of western hemlock at the rate of more than 1,000,000 per acre. With age most of the seedlings die, until the mature forest may not contain more than 300 to 500 trees per acre, exclusive of seedlings. Stands of all ages are represented in the quadrangle. The oldest and largest growth occurs in the Priest River Valley, where occasional stands from 400 to 500 years old are found. The dimensions of the white pine and western tamarack in these old stands reach 4 to 6 feet in basal diameters and of 200 feet in height. South of Pend Oreille River much of the type is composed of standards or middle-aged growths where the extreme basal diameters rarely exceed 4 to 5 feet, with heights varying from 150 to 175 feet. Humus and litter are both abundant in the stands of the type, and the humus not infrequently reaches a depth of 5 inches. In stands of old growth undergrowth is not very plentiful, either as young trees or as species of shrubs. But in middle-aged or in young growth stands the undergrowth, partly in the form of small saplings, partly as various species of shrubs, is extremely plentiful and dense.

The economic value of the type as a whole is not now very great in this region. This is due to the widespread ravages by fire during the past forty years. In exceptional localities, such as the central areas of the Priest River Basin, there are small tracts which have escaped the fires, and there the timber value of the type is considerable. Elsewhere 50 per cent of the type has been burned outright and the remainder has suffered so severely from fire scars and other forms of damage following the conflagrations that it is of comparatively little value. Logging operations in the type have been carried on throughout the accessible areas, except in the central Priest River Basin, during the past sixteen years. The cutting has been confined almost wholly to the Pacific arbor vitæ for shingle bolts and telegraph poles and to the small-sized western tamarack for railroad ties. Little saw timber has been cut, chiefly owing to the difficulty and cost of bringing the logs from the forest to the mills. In general the stands of the type are not so accessible as those of the yellow-pine and red-fir types.

The capacity of the type in mill timber per acre varies within very wide limits. For old-growth stands, composed chiefly of white pine and western tamarack and growing in good soil, 100,000 to 150,000 feet B. M. is an extreme limit. For middle-aged or standard growths under the more common conditions of soil and moisture prevalent in the region 25,000 to 40,000 feet B. M. is an average yield. Owing to the enormous damage from fire in the type the average stand of mill and tie timber throughout the entire area included within the quadrangle is about 8,000 feet B. M. per acre.

Reproduction of the type after fires is subject to great variations, but in almost every instance it depends upon changes in the soil moisture. On the summits and slopes of ridges reforestation is generally preceded by a period of brush growth. On flats and along the margins of streams and marshy ground coniferous species usually come in as the first growth subsequent to fires. But one can never predict from any data which we now possess the exact or even approximate composition of the coming reforestation under any of these conditions.

The areas covered by the type are slowly diminishing in acreage, owing to clearings for purposes of agriculture. Only the high cost attendant upon the clearing of lands so heavily covered with timber, brush, or half-burned stumps has prevented a general occupation of all level tracts bearing the type. Practically all of the region embraced in the type is frosty, and the land when cleared can not be depended on for sure returns in agricultural products.

ALPINE-FIR TYPE.

The alpine-fir type is the prevailing forest on the summits and slopes above the 5,200-foot contour line in the region. It covers, collectively, an area of 53,000 acres. It occurs chiefly north of the Pend Oreille River, on the divides which inclose the Priest River Basin on the west and east, as well as on the summits of many of the spurs and ridges in the central portions of the basin. South of the Pend Oreille River the type is scarce, occurring chiefly on the ridges west of Hoodoo Lake. The principal components of the type are lodgepole pine, white-bark pine, and alpine fir. The white-bark pine occurs only on the areas north of the Pend Oreille River; south of this stream the type is made up of lodgepole pine and alpine fir. In addition to these species there are generally to be found scattered trees of Engelmann spruce, white pine, and western tamarack along the lower edges of the altitudinal range of the type.

Most of the type consists of alpine fir. The white-bark pine component is never present in any but very small quantities. The percentage of lodgepole pine depends on the extent to which any particular area has been devastated by fire in the past, as this species owes its presence as a notable factor in the type to fire and subsequent reforestation. Generally the alpine fir forms from 50 to 75 per cent of the stands, the remainder being composed of white-bark pine and lodgepole pine.

The aspect of the type varies from very dense in sapling stands to open and park-like in old or middle-aged growths. The trees rarely attain greater heights than 50 to 75 feet; they are always deficient in trunk development and have an ample crown. At the highest altitudes undergrowth is scanty and is composed of huckleberry and menziesia shrubs, or it is entirely lacking and the forest floor is covered with a thick sward of grass, sedge, or "beargrass" (*Xerophyllum*). On northern slopes with plenty of seepage the undergrowth generally becomes exceedingly dense and consists of menziesia, willow, huckleberry, and vellum-leaved ceanothus.

The type is of little economic importance. None of the species which form its stands produce mill or tie timber, nor have they a fuel value. The scattered white pines, tamaracks, and spruces along the lower limits of the type have sufficiently large dimensions to furnish mill timber, but grow in inaccessible places. The average stand in merchantable timber for the entire area covered with the type is estimated not to exceed 300 feet B. M. per acre. Most of the stands are fire marked, and they are everywhere separated by open, grassy, nonforested tracts, the result of fires centuries ago.

CLASSIFICATION OF AREAS.

	Acres.
Total area of quadrangle	537, 000
Forested and wooded area	477, 000
Lakes, streams, and marsh	44, 000
Clearings and natural meadow	16, 000
Area marked by fire during the last 40 years	420, 000
Area badly burned, destruction 75 per cent and upward	57, 000

TABULATED ESTIMATES OF MILL TIMBER.

Total stand of mill timber above 18 inches basal diameter, Sandpoint quadrangle, Idaho.

Acres.	Feet B. M.	Feet B. M. per acre.
237, 000	237, 000, 000	1, 000
122, 000	488, 000, 000	4, 000
80, 000	640, 000, 000	8, 000
34, 000	578, 000, 000	17, 000
4, 000	160, 000, 000	40, 000
477, 000	2, 103, 000, 000	....

By including dimensions of which the two lower cuts will face 9 inches, or a standard first-class tie, the above total will be increased 50 per cent, making a grand total of mill and tie timber of 3,154,500,000 feet B. M.

The mill timber of standard dimensions is distributed among the different species as follows:

Distribution of mill timber according to species in Sandpoint quadrangle, Idaho.

	Feet B. M.
Yellow pine	500, 000, 000
White pine	600, 000, 000
Red fir	300, 000, 000
Tamarack	550, 000, 000
Pacific arbor vitæ (cedar)	130, 000, 000
Western hemlock and Engelmann spruce	23, 000, 000
Total	2, 103, 000, 000

The increase of 50 per cent, or 1,056,500,000 feet B. M., if the tie timber be included in the general estimates, consists wholly of red fir and tamarack in the following proportions:

	Feet B. M.
Red fir	600, 000, 000
Tamarack	456, 650, 000
Total	1, 056, 650, 000

HAMILTON QUADRANGLE, MONTANA-IDAHO.

This quadrangle is situated in western Montana and eastern Idaho, the State line following the crest of the Bitterroot Range through the western part of the quadrangle. This range, which covers the west half of the quadrangle, is extremely rugged, rising abruptly from altitudes of 4,000 or 5,000 feet in the Bitterroot Valley on the east to a summit exceeding 10,000 feet in a distance of 6 miles. The range is very broad, extending far to the westward, beyond the limits of the quadrangle, and the divide is near the eastern edge of the range. This part of it is drained to Bitterroot River by many small streams flowing with steep slopes and in very straight courses to the eastward. The high summits of the range are upon spurs east of the divide, indicating that the divide is migrating westward.

The valley of the Bitterroot is broad and nearly level, and with the abundance of water flowing in the river and joining it from the Bitterroot Range nearly all of the area of the valley can be placed under irrigation and cultivated. East of the valley, along the eastern edge of the quadrangle, rises a range of hills, mainly grass covered, or timbered only in the southern part.

But little of the Bitterroot Range within this quadrangle is timbered. The timbered portions consist of the lower slopes of the mountains upon the east and the heads of the canyons upon the west.

Of the entire area of the quadrangle (827 square miles), 267 square miles only, a little more than one-fourth, is timbered, of which 27 square miles consist of scattering timber of inferior quality. Of the nontimbered area, 242 square miles are rocky and barren, containing the higher parts of the Bitterroot Range; 179 square miles are irrigable and are now under ditch; 123 square miles, lying mainly in the eastern part of the quadrangle, consist of grazing land; 9 square miles have been burned, and 7 square miles have been denuded of timber by the ax.

The timber east of the Bitterroot Mountains consists almost entirely of yellow pine, a little red fir only being found intermingled with it. Upon the west side there is greater diversity in the timber species, since it consists of yellow and lodgepole pine, with a larger proportion of fir and here and there a little cedar. The stand of timber varies widely, ranging from less than 1,000 feet per acre up to 50,000 feet. Even the yellow-pine forests upon the east side of the range present much diversity in the stand of timber, although this is the species which commonly has a very uniform stand. The total stand of timber upon the area of this quadrangle is estimated at 750 million feet B. M.

FORTYMILE QUADRANGLE, ALASKA.

By E. C. Barnard.

The entire area of this quadrangle is fairly well timbered to an altitude of 3,000 feet, save some areas which have been burned over, on which there appears little indication of reforesting.

On the north slopes higher up the timber is scrubby, but the trees retain a good size in the high, protected gulches and gaps even to 3,200 feet.

The largest and most valuable timber is the white spruce (*Picea alba*), which attains a height of 50 to 100 feet and a diameter of 15 to 22 inches. This wood is close and straight grained, easily worked, and quite durable.

Next in importance is the white birch (*Betula papyrifera*), which reaches a diameter of 12 inches and is the only hard wood found in this section. It is found on the flats and low foothills.

Several species of poplar (*Populus balsamifera* and *P. tremuloides*) are found along the water courses, frequently occurring in groves. They attain a diameter of 4 to 6 inches, but are soft and of very little use save for fuel.

Willows and alders grow on the stream banks, but seldom attain over 3 inches in diameter and are only useful for fuel.

Varieties of wild grass grow in the bottoms, gaps, and numerous flats. This is nutritious and would furnish sufficient feed for pack animals during the months of July, August, and September.

Of the entire area of the quadrangle (2,069 square miles), 1,427 square miles are covered with timber, 588 square miles are barren, lying above timber line, and on 54 square miles the timber has been destroyed by fire.

DAYTON QUADRANGLE, WYOMING.

This quadrangle, comprising an area of 850 square miles, lies in northern Wyoming, the northeastern half of the quadrangle consisting of plains, the southwestern half of the Bighorn Mountains. The plains have an undulating surface with a general eastward slope and are treeless, with the exception of narrow lines of cottonwood along the streams. Being in the arid region, the cultivation of the soil is dependent upon irrigation and the cultivated areas therefore border the streams closely; altogether areas aggregating 51 square miles are under cultivation. The remaining portion of the plains part of this quadrangle is used for pasturage, principally for cattle.

From the edge of the plains the mountains rise very abruptly, the beds of stratified rocks being suddenly inclined upward at high angles, forming a line of hogbacks, or rim rocks, as they are locally known, flanking the Bighorn Range. These rim rocks rise to altitudes of from 7,000 to 7,500 feet. Within them, rising to somewhat higher altitudes, are granites, forming the core of the mountain range. The summit of this range has the general form of an undulating plateau having an altitude ranging from 8,000 to 9,000 feet, with here and there rock and granite points rising to greater altitudes. While in the granite the streams flow through shallow valleys, excavated a little below the general level, but upon nearing the rim rocks they begin to cut deeper and in passing through them down to the plains they cut deep gorges.

The surface of this range or plateau presents great variety in the character of its vegetation. It is in part covered with solid forests, in part with scattering growths and single trees, and in great part consists of open parks covered with carpets of grass. For this condition of things fire is largely responsible. The forests are nowhere composed of old trees, and in most places they are composed of very young trees—mere saplings. Over extended areas the dead timber, fire killed, covers the ground with an intricate cobwork, showing the effect of recent fires. The timber consists almost entirely of lodgepole pine, a species of little value for milling purposes, even when of sufficient size.

The timber areas, which are all comprised within the mountain section, aggregate 216 square miles. Areas of pasture lands, which are mainly upon the plains, measure 406 square miles. There are 57 square miles of barren mountain lands, and 119 square miles upon which the forests have been destroyed by fire. An area of 51 square miles, lying entirely on the plains, is under cultivation.

These mountain pasture lands are of the greatest value as a summer range for sheep, and are largely used for that purpose. When the summer heats parch and destroy the pasturage upon the lower plains, the grasses are in their prime in this high country and the flocks are driven hither to subsist until the approach of winter. Without the pasturage supplied by the parks of the Bighorn Range it is probable that the sheep industry of Wyoming would suffer greatly.

BALD MOUNTAIN QUADRANGLE, WYOMING.

The forests of the Bald Mountain quadrangle are restricted to the Bighorn Range.

A large portion of the area being near or above timber line, 9,500 feet, is sparsely timbered or bare, such areas amounting to 237 square miles. Large areas of the remainder, altogether 334 square miles, are grass covered. The heaviest bodies of timber are on the sloping mesas at the headwaters of the Little Horn River, the south end of the high hogback east of the Dry Fork of the Little Horn River, and the drainage of Porcupine Creek. More or less second growth and dead timber is mixed with what at first appears to be heavy timber. The entire wooded areas amount to only 209 square miles, including 45 square miles of scattering timber. There is practically no virgin forest. It is probable that the whole mountain area has been swept by fire, and portions of it have been burned several times during the past fifty years.

While only 55 square miles have been freshly burned, at least 30 per cent of the timber has been completely destroyed by fires within the past fifteen years and 70 per cent badly damaged.

The largest burned areas include the rimrock east of the Little Horn River, the drainage of Pass Creek on its eastern slope, the lower portion of the Little Horn River, ridges northwest of Sheep Mountain, the north side of Shell Creek and its tributaries, Granite and Cedar creeks.

The park areas below timber line have evidently once been timbered, and they are now encroaching rapidly on the surrounding forests.

Evidence has been obtained to show that certain areas which were forested twelve years ago are now, with the exception of a stump and a log here and there, practically parks.

Lodgepole pine seems to be the only species capable of reproducing itself after destruction by fire, under certain conditions, depending upon the severity of the first fire and the intervals between the successive ones.

The prevailing forest tree is lodgepole pine, which forms probably 85 per cent of the whole. It is the only species that exclusively occupies large areas. It is rarely over 18 inches in diameter and 80 feet in height. Up to 7,000 feet elevation is considerable red fir, with yellow pine at the lowest and driest situations.

Engelmann spruce is found scattered here and there, in canyons and on north slopes, mixed with more or less balsam and fir, these two species being stunted shrubs at timber line. Occasionally spruce is found in small groves in the canyons, of good size, 18 inches to 2 feet in diameter. In the Bighorn Basin there is considerable cottonwood scattered along the upper portions of the streams, especially on Shell Creek, which furnishes firewood for the farmers.

There is no chaparral or brush, except a scattering growth of mountain mahogany on the abrupt rocky slopes, 6,000 to 8,000 feet in altitude, bordering the mountains on the west.

No lumbering to any extent has ever been done in the Bald Mountain quadrangle. Dayton, Wyoming, obtains a small quantity of lumber of poor quality from a sawmill just beyond the eastern margin of the quadrangle, a mile north of the Dayton-Bald Mountain wagon road. Some cutting for local needs has been done on the lower portion of West Pass Creek. A large number of railroad ties have been cut in recent years on Sheep Creek and Tongue River, the cut-over area hardly reaching within the quadrangle on the east.

About 10,000 sheep and 2,000 cattle were pastured on the mountain parks during the past season.

The whole mountain area is too high for agriculture. In the Bighorn Basin near the mountains is fair pasturage for sheep. Several miles from the mountains the area is of bad-land character and practically destitute of vegetation.

The cultivated areas altogether cover 14 square miles. On Bear and the upper portion of Beaver Creek are several small irrigated ranches. The best agricultural lands are on Lower Beaver, Fish, and Lower Trapper creeks and the whole length of Shell Creek from the mouth of the canyon. Fine hay, alfalfa, grain, and vegetables are raised along Shell Creek, and the water supply is ample for all needs of irrigation. All the bottom land along Shell Creek is practically taken up by farmers.

CLOUD PEAK QUADRANGLE, WYOMING.

The map represents not only the Cloud Peak quadrangle, but a strip on the west edge of the Fort McKinney quadrangle, a total area of 1,021 square miles being represented. It includes the high part of the Bighorn Range, with Cloud Peak as a culminating point, with an altitude of 13,000 feet. On the west it includes the rim rock of the range and the slope to the Bighorn Basin; on the east it does not extend quite to the rim rock.

The surface of the range here consists of steeply inclined rim rocks and high hogbacks of sandstone, inclosing an elevated plateau of undulating surface of granite, having an elevation ranging from 8,000 to 9,000 feet. Rising from this plateau, near its middle line, is a granite range, elevated 3,000 to 4,000 feet above the plateau and extremely rugged, being mainly glacier carved and likewise composed of granitic rocks. This upper range is almost entirely rocky and barren, including an area of 161 square miles.

The plateau from which it rises contains all the woodland within the area, comprising altogether 454 square miles, half of which is young and scattering growth consisting of reproduction after recent fires.

The timber consists almost entirely of lodgepole pine. It nowhere grows large and the lumber from it is inferior. If it were not practically the only available timber for long distances it would be regarded as valueless for lumber. Mingled with it is a little red fir and at lower elevations some yellow pine; at greater elevations Engelmann spruce and balsam fir are found with the lodgepole pine.

Intermingled with the wooded areas upon the plateau are numerous bodies of open grass land, furnishing in the summer most excellent grazing ground for cattle and sheep. These collectively amount to 357 square miles. The cultivated lands are confined to a half dozen patches in the southwestern part of the quadrangle and collectively have an area of but 4 square miles. There is sufficient water in the streams to irrigate large areas, and irrigation will doubtless be practiced as development progresses.

While the entire area of this quadrangle has been burned repeatedly, and much of it within the past generation, the area subjected to recent fire—that is, fire occurring within the last ten years—is estimated at 45 square miles.

NEWCASTLE QUADRANGLE, WYOMING-SOUTH DAKOTA.

This quadrangle lies mainly in eastern Wyoming, including only a narrow strip of South Dakota 2½ miles in width, stretching along its eastern border. It consists mainly of open plains, covered with a sparse growth of bunch grass, forming a wide cattle range. In the northern and eastern portions of the area are bodies of timber, consisting of open growth of yellow pine, most of which is of sufficient size for milling purposes, and all of which is of great economic value to the settlements in the neighborhood.

The area is on the border land of the arid region, where farming without irrigation is hazardous; still, considerable areas are thus cultivated.

The total area of the quadrangle is 864 square miles, of which 696 square miles consist of grass land, largely occupied by range cattle; 155 square miles are covered with merchantable timber, and 13 square miles are under cultivation.

WOODLAND OF INDIAN TERRITORY

BY

C. H. FITCH

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WOODLAND OF INDIAN TERRITORY.

By C. H. Fitch.

INTRODUCTION.

Reference has been made in previous reports of the Survey to the subdivision of lands in Indian Territory during the years 1895 to 1898, and the results of the topographic and land survey have been, or are about to be, published. It is the purpose here to submit a special report on the woodland of Indian Territory, compiled from information obtained from the plats and field notes, not, however, including a report on the economic value or stand of merchantable timber, the data for which have not as yet been obtained. Consideration is here given to the distribution of woodland and the character of timber found in the lands of the Cherokees, Creeks, Seminoles, Choctaws, and Chickasaws, but not the Indian lands of the Quapaw Agency, occupying the extreme northeast corner, which lands, having long since been subdivided, were not entered upon by this Survey.

The character of the topography is diversified, ranging from high, rugged hills to smooth, rolling prairies. The rougher portion lies east of the line of the Missouri, Kansas and Texas Railway, and its highest and most rugged area is along the Arkansas boundary, this region being the western limit of the Ozark Plateau. In the middle and western portions the hills are lower, and much of the area is undulating, the only group of hills of any note in that section being the Arbuckle Mountains, covering about 100 square miles. The elevation above sea level at the lowest point in the Territory is about 350 feet, and at the highest about 2,700 feet. The larger streams are generally broad and shallow, flowing through wide valleys, most of which are yearly inundated by spring floods.

The lands occupied by the Five Civilized Tribes, above mentioned, contain an area of 30,660 square miles of land surface, of which 18,925 square miles, or nearly 62 per cent, are wooded. The accompanying map (Pl. CXLII) shows the distribution of the woodland, and, as will be readily seen at a glance, the timber, although well distributed over the entire area, is most abundant and compact on the eastern side, and as a rule where the contour lines show the elevation to be greatest, although in that, as well as in other portions, the river-bottom lands are heavily and densely wooded. The timber of this area is of great variety, including many oaks; but more abundantly than all others occur the black-jack (*Quercus marilandica*) and post oak (*Quercus minor*). Of other species we find the most important trees to be the loblolly pine (*Pinus tæda*), black walnut, white oak, and cedar, all of which are of commercial value; and in addition ash, pecan, cottonwood, bois d'arc, sycamore, elm, hackberry, maple, plum, hickory, elder, gum, mulberry, locust, river birch, and shittim wood are found frequently mentioned in the field notes of the surveyors. Pine is found only in the mountainous portion of the eastern part of the Territory, its range being confined to a limited area. It grows with other trees and is nowhere very abundant, and in many places is inaccessible, while much of it growing nearest railroads and mills has been cut, principally for local consumption. Black-walnut logs of large size have been easily obtained in the river bottoms, and much has already been shipped out of the Territory. Some of the cedar has also been cut for shipment, and oak, ash, and hickory for fuel, bois d'arc for fence posts, and oak for railroad ties. The timber west of the Missouri, Kansas and Texas Railway may be considered as a part of the belt of woodland extending through Texas, Indian Territory, and Oklahoma into southern Kansas, known as the "Cross Timbers." Growing on sandy or rocky soil of the uplands are found many varieties of oaks, but particularly post oak and black-jack, and on the river bottoms walnut, cottonwood, pecan, elm, gum, maple, etc. In the western and northern portions a view of the country gives the impression of more extensive timberless areas than really exist, for the reason that in the prairie country, although the streams are generally wooded along their margins, the belts of timber are as a rule low, and the stretches of prairie appear wider than is actually the case.

The following notes are taken from the general descriptions of the character of the timber found in each township, as given by the surveyors.

DETAILED DESCRIPTIONS.

Townships 1–4 South, Ranges 8–12 East.

T. 1 S., R. 8 E. (*Choctaw Nation*).—The principal kinds of timber in this township are oak, ash, elm, hickory, and bois d'arc.

T. 2 S., R. 8 E. (*Choctaw Nation*).—This township is about half wooded. Much valuable timber is found along the creek bottoms, consisting of oak, ash, walnut, pecan, sycamore, and bois d'arc.

T. 3 S., R. 8 E. (*Choctaw Nation*).—This township has a large quantity of fine timber, consisting of oak, ash, elm, bois d'arc, walnut, hickory, and pecan.

T. 4 S., R. 8 E. (*Choctaw Nation*).—This township is generally wooded. There is considerable valuable timber in the bottoms, the principal varieties being oak, ash, pecan, walnut, and bois d'arc.

T. 1 S., R. 9 E.—The timber is oak, ash, elm, and hickory.

T. 2 S., R. 9 E.—Oak, ash, elm, hickory, bois d'arc, and other kinds of timber are found in great abundance, but of inferior quality.

T. 3 S., R. 9 E.—This township is partly rolling timbered land, containing a growth of oak, elm, and hickory. The creek bottoms have oak, elm, ash, and walnut timber.

T. 4 S., R. 9 E.—About half of the land of this township is covered with oak, elm, hickory, and bois d'arc timber.

T. 1 S., R. 10 E.—In the eastern half of township very little timber is found. A few small prairies are located in the northwestern part. Oak, ash, elm, and hickory are found in elevated portions, while hackberry, sycamore, and cottonwood are found along the creek bottoms.

T. 2 S., R. 10 E.—The western part is covered with a growth of timber, consisting of oak and hickory in the higher and ash, elm, bois d'arc, and sycamore in the lower portions.

T. 3 S., R. 10 E.—This township is almost entirely covered with a thick growth of timber, particularly along the banks of the creeks, where elm, sycamore, and bois d'arc are found in abundance, together with a dense undergrowth. Species of oak and ash are found in the more elevated portions.

T. 4 S., R. 10 E.—This township is almost entirely wooded. In the rich bottom land is heavy timber, consisting of oaks, elm, ash, hickory, walnut, pecan, and bois d'arc.

T. 1 S., R. 11 E.—The northern portion of this township is mountainous and covered with a scrubby growth of oak timber. Along Muddy Boggy Creek there is an abundant growth of various kinds of timber. The surface of the remaining part of the township is rolling and covered with timber with the exception of a few openings of prairie in the west and center. The timber consists of oak, elm, hickory, pecan, and bois d'arc.

T. 2 S., R. 11 E.—The surface of this township is rolling, with the exception of the northwest portion, which is broken. There is one large prairie near the center and a few openings in the north and west parts of the township. The remainder is covered with a heavy growth of timber consisting of oak, hickory, elm, and bois d'arc.

T. 3 S., R. 11 E.—This township is covered with timber, consisting of oak, elm, hickory, and ash.

T. 4 S., R. 11 E.—This township consists of sandy oak-covered ridges and rich bottom lands along Clear Boggy Creek. The Boggy bottom contains valuable timber, which consists of oak, ash, elm, hickory, pecan, walnut, sycamore, and bois d'arc.

T. 1 S., R. 12 E.—This township is well wooded, with the exception of a few small prairies. The timber consists of oak, pine, elm, and hickory.

T. 2 S., R. 12 E.—This township is nearly all wooded. Elm, ash, walnut, and other kinds of timber are found along Muddy Boggy Creek and its tributaries.

T. 3 S., R. 12 E.—This township, which is entirely wooded, consists of gently rolling land covered with oak, hickory, and elm along creeks and in low depressions.

T. 4 S., R. 12 E.—This township is entirely wooded and consists mostly of sandy ridges covered with timber of oak, hickory, elm, and ash. Much fine timber grows along Boggy Creek bottom, consisting chiefly of oak, ash, elm, hickory, sycamore, and bois d'arc.

Townships 1-4 South, Ranges 13-16 East.

T. 1 S., R. 13 E.—In this township the lumber business is carried on on a small scale. The rough and rocky character of the surface renders the hauling of lumber expensive. A sawmill is located in section 35.

T. 2 S., R. 13 E.—Three-fourths of this township is wooded. Oak, pine, hickory, elm, ash, and shittim are found, but oak and pine predominate. The pine timber is rapidly being cut and converted into lumber. The oak is scrubby and worthless.

T. 3 S., R. 13 E.—This township is all in timber of an inferior quality, with the exception of the pine, which is found along the east side of the township. A large sawmill is being operated near the northeast corner of the township, and the pine is rapidly being cut and converted into lumber.

T. 4 S., R. 13 E.—This township is all timbered. The timber consists of oak, ash, elm, hickory, walnut, pecan, hackberry, birch, maple, and pine, oak of an inferior quality predominating. A sawmill is located in sec. 35.

T. 1 S., R. 14 E.—This township is almost entirely timbered. The more elevated portions are covered with a growth of pine, oak, ash, and hickory; along the creek bottoms elm, sycamore, walnut, and persimmon are found in abundance, together with a dense undergrowth of vines and briers.

T. 2 S., R. 14 E.—This township is nearly all wooded and contains some good pine timber.

T. 3 S., R. 14 E.—This township contains mostly rolling, wooded land. The timber consists of oak and hickory, but it is generally of an inferior quality.

T. 4 S., R. 14 E.—This township is entirely wooded and is generally low, bottom land, covered with a growth of ash, elm, walnut, hickory, cottonwood, sycamore, hackberry, and pecan timber. The northern part of the township is rolling, timbered land.

T. 1 S., R. 15 E.—This township is all wooded. Sycamore, walnut, ash, elm, and oak are found on Tenmile and Buck creeks. Oak, hickory, and pine are found in the mountains.

T. 2 S., R. 15 E.—This township is three-fourths wooded. Oak, elm, hickory, pine, and sycamore are found on Tenmile and Buck creeks.

T. 3 S., R. 15 E.—The north portion of this township is mountainous and covered with a scrubby growth of oak. The surface of the remaining portion is rolling and covered with timber, with the exception of a few openings of prairie in the west and central portions. Oak, elm, and hickory are the principal trees.

T. 4 S., R. 15 E.—This township is all wooded. The timber consists of a heavy growth of oak and hickory, some of good quality.

T. 1 S., R. 16 E.—The timber in this township is oak, pine, and elm.

T. 2 S., R. 16 E.—This township is rough land, consisting almost wholly of rocky ridges, covered with a growth of pine, elm, oak, and hickory timber. In the river bottom oak, elm, pine, hickory, ash, gum, walnut, sycamore, cottonwood, hackberry, pecan, and cedar are found.

T. 3 S., R. 16 E.—The entire surface of this township is covered with a growth of timber. Oak, ash, cottonwood, elm, and sycamore are found along Kiamichi River. The mountains in the northern portion are covered with a heavy growth of pine and oak.

T. 4 S., R. 16 E.—This township is nearly all wooded. The timber is oak, elm, and ash.

TOWNSHIPS 1–4 SOUTH, RANGES 17–20 EAST.

T. 1 S., R. 17 E.—The timber along the river is elm, ash, and hickory, nearly all of which is of inferior quality. The mountains are covered with pine of considerable size and value. A sawmill is located in section 32. There is also one in section 26.

T. 2 S., R. 17 E.—With the exception of the southeast corner, this township is composed of rough and rocky ridges, covered with a growth of oak, pine, and hickory timber. Oak, elm, ash, pecan, walnut, and hickory timber grows along Cedar Creek. Sawmills are located in secs. 16 and 29, and they have cut most of the valuable timber.

T. 3 S., R. 17 E.—This township is principally of rolling, wooded land, covered with a growth of pine, oak, and hickory. Ash, elm, pecan, and walnut grow along the creeks.

T. 4 S., R. 17 E.—With the exception of the Kiamichi River bottom, this township is made up of rolling, timbered land, covered with a growth of oak, pine, and hickory. The bottom is low and flat, covered with a heavy growth of oak, elm, pine, ash, sycamore, pecan, walnut, hackberry, and hickory timber. Most of the valuable timber has been cut in this township, particularly the pine. There is a sawmill in section 24, and several old sawmill sites are found over the township.

T. 1 S., R. 18 E.—This township is composed of rough, broken, wooded land, covered with a growth of oak, pine, and hickory timber.

T. 2 S., R. 18 E.—The township is covered with a dense growth of pine, oak, and hickory timber, with some very good cedar in the bottoms of the canyons. The oak is fit only for fuel, while the pine is of excellent quality.

T. 3 S., R. 18 E.—The whole township is covered with a dense growth of pine and oak timber. The pine is of fairly good quality, but the oak is scrubby and useless except for fuel.

T. 4 S., R. 18 E.—This township contains mostly rolling timbered land.

T. 1 S., R. 19 E.—This township is very rough on the north and south, being made up of rocky ridges covered with a growth of oak, pine, and hickory timber. The land is worthless except for timber. The pine is nearly all cut.

T. 2 S., R. 19 E.—All wooded, the timber being scrub oak, pine, and hickory.

T. 3 S., R. 19 E.—Township is all wooded; the timber is of poor quality, being scrub oak and pine.

T. 4 S., R. 19 E.—This township is all open timbered land, with a few small openings.

T. 1 S., R. 20 E.—A good quality of timber is found all over the township, consisting of pine, oak, and hickory. An exceptionally good quality of white oak is found along Little River.

T. 2 S., R. 20 E.—This township is all wooded. The timber is of good grade, consisting of pine, hickory, and the various species of oak. Along the banks of Little River some elm and sycamore is found.

T. 3 S., R. 20 E.—This township is all wooded, the timber being mainly oak and pine. Some elm and hickory is found along the different water courses.

T. 4 S., R. 20 E.—The township is all wooded, excepting a few small prairies, the edges of which are thickly covered with undergrowth. The timber consists of the various species of oaks, pines, and hickory.

Townships 1–4 South, Ranges 21–24 East.

T. 1 S., R. 21 E.—The greater part of this township is composed of high sandstone hills and mountains, covered with pine and oak.

T. 2 S., R. 21 E.—The township is all wooded. The timber is of little value and comprises oak and pine on the ridges and ash, elm, gum, maple, and hickory in the valleys.

T. 3 S., R. 21 E.—This township is all wooded. The timber consists of the various species of oak, hickory, and a good quality of pine.

T. 4 S., R. 21 E.—This township is entirely wooded. The principal timber is oak and pine.

T. 1 S., R. 22 E.—The timber in the township is pine, oak, and hickory, all of the township being wooded.

T. 2 S., R. 22 E.—The timber, which covers the entire township, is mostly pine and oak, scrubby and of no value.

T. 3 S., R. 22 E.—This township is all wooded. The timber is of a poor quality, except the pine, which is very good, though there is not a great quantity of it.

T. 4 S., R. 22 E.—The timber covers the entire township and consists of pine and oak, but the oak is of poor quality.

T. 1 S., R. 23 E.—The land is all heavily wooded with a growth of oak, pine, and hickory timber, some of which is of value, particularly the pine.

T. 2 S., R. 23 E.—Pine and oak are the prevailing timbers, covering the entire township.

T. 3 S., R. 23 E.—There is an abundance of timber over all the township, the ridges being covered with a heavy growth of pine and various species of oak. The valleys have some elm, ash, and hickory.

T. 4 S., R. 23 E.—The timber, which covers the township, consists of oak, ash, elm, hickory, cedar, and pine.

T. 1 S., R. 24 E.—The timber is oak, pine, and hickory, all of poor quality. It is found throughout the township.

T. 2 S., R. 24 E.—The township is entirely wooded; the timber is of very poor quality, consisting of pine, oak, and hickory.

T. 3 S., R. 24 E.—The timber, consisting of oak, pine, and hickory, is abundant and found all over the township, but is of little value.

T. 4 S., R. 24 E.—All of the land is covered with oak and pine timber, with a few hickory and cedar trees in the bottoms of the canyons. The pine is fairly good, but the other varieties of timber are fit only for fuel and fencing.

TOWNSHIPS 1–4 SOUTH, RANGES 25–27 EAST.

T. 1 S., R. 25 E.—The timber is pine, oak, elm, hickory, ash, and walnut.

T. 2 S., R. 25 E.—The northeast portion of this township is rolling wooded land. The timber is principally oak, pine, and hickory.

T. 3 S., R. 25 E.—The timber consists of pine, oak, elm, ash, hickory, and gum.

T. 4 S., R. 25 E.—The entire township is covered with heavy timber, which consists of species of oak, hickory, pine, gum, cypress, and cedar, the white oak and pine being suitable for lumbering purposes.

T. 1 S., R. 26 E.—The entire township is covered with a dense growth of oak, pine, and hickory timber.

T. 2 S., R. 26 E.—The entire area is covered with oak, pine, and hickory timber, which is of no commercial value.

T. 3 S., R. 26 E.—The timber, which covers the entire area, comprises oak, pine, and hickory, of no commercial value.

T. 4 S., R. 26 E.—The southern portion of this township is open and of little commercial value, consisting chiefly of pine and white oak, with some hickory.

T. 1 S., R. 27 E.—This township is entirely wooded.

T. 2 S., R. 27 E.—This township is entirely wooded.

T. 3 S., R. 27 E.—The timber consists of oak, pine, and hickory. The white oak is of fair quality.

T. 4 S., R. 27 E.—The entire township is covered with pine, oak, hickory, and gum timber of poor quality, except the white oak, which is good.

Townships 5–8 South, Ranges 8–12 East.

T. 5 S., R. 8 E. (*Choctaw Nation*).—The creeks are skirted with timber, consisting of oak, elm, ash, pecan, and hickory.

T. 6 S., R. 8 E. (*Choctaw Nation*).—This township is about half wooded. Timber is found along the creeks and in the northern part.

T. 7 S., R. 8 E. (*Choctaw Nation*).—The timber on the banks of Island Bayou consists of oak, ash, elm, hickory, hackberry, sycamore, and cottonwood.

T. 8 S., R. 8 E. (*Choctaw Nation*).—This small fraction is wooded.

T. 5 S., R. 9 E.—The western third of the township is flat and wooded, and there is a strip of timber found along the bottom land of Blue River, extending about 1 mile on either side and consisting of the various species of elm, ash, bois d'arc, sycamore, cottonwood, hackberry, locust, walnut, hickory, pecan, and mulberry.

T. 6 S., R. 9 E.—Nearly all the land throughout this township is high and rolling, covered with a dense growth of oak, elm, ash, hickory, and bois d'arc timber.

T. 7 S., R. 9 E.—The creeks are skirted with oak, elm, ash, pecan, and hickory timber.

T. 8 S., R. 9 E. (*Choctaw Nation*).—The timber consists of oak, hickory, pecan, walnut, cottonwood, and elm, along the creeks.

T. 5 S., R. 10 E.—Along the few creeks there are dense thickets and some elm and bois d'arc timber.

T. 6 S., R. 10 E.—This township contains rolling and level land, partly covered with timber, consisting of oak, hickory, elm, and ash.

T. 7 S., R. 10 E.—The timbered land is almost entirely along the water courses.

T. 8 S., R. 10 E. (*Choctaw Nation*).—This township, with the exception of rolling prairie in northern and eastern part, is wooded. The timber consists of oak, elm, ash, walnut, pine, hickory, sycamore, dogwood, bois d'arc, hackberry, and cottonwood, all growing in abundance.

T. 5 S., R. 11 E.—This township is largely rolling prairie, except a narrow strip along the north boundary, which is heavily timbered with the various species of oak, hickory, and bois d'arc.

T. 5 S., R. 12 E.—Partly wooded. The timber consists of oak, elm, ash, walnut, pecan, hickory, hackberry, bois d'arc, and sycamore.

T. 6 S., R. 12 E.—This township is nearly all covered with oak, elm, hickory, ash, and bois d'arc timber, which is valuable chiefly for fencing and fuel.

T. 7 S., R. 12 E.—The township is a gently rolling and level surface, for the most part heavily wooded. The timber consists of the various species of oak, elm, hackberry, sycamore, walnut, pecan, hickory, cottonwood, bois d'arc, and some mulberry.

T. 8 S., R. 12 E.—The timber consists of oak, ash, elm, pecan, hickory, cottonwood, and willows.

Townships 5–8 South, Ranges 13–16 East.

T. 5 S., R. 13 E.—Timber, consisting of oak, hickory, gum, hackberry, and bois d'arc, is found in abundance along Clear Boggy Creek.

T. 6 S., R. 13 E.—With the exception of a few small prairies on the north boundary, this township is rolling land, covered with a growth of oak and hickory timber.

T. 7 S., R. 13 E.—This township is nearly all rolling wooded land, interspersed with a number of small prairies. White Grass Creek has in places some very wide, fertile bottom lands, heavily timbered with oak, elm, ash, sycamore, cottonwood, and undergrowth. A variety of timber is found in this township, viz, oak, elm, ash, sycamore, cottonwood, bois d'arc, hackberry, persimmon, locust, walnut, hickory, pecan, and dense undergrowth.

T. 8 S., R. 13 E.—The timber consists of oak, hickory, elm, bois d'arc, hackberry, cottonwood, and sycamore, of little value commercially.

T. 5 S., R. 14 E.—This township is principally low, swampy bottom, covered with heavy timber and dense undergrowth. Clear Boggy Creek is timbered along its banks with oak, ash, elm, hickory, walnut, pecan, birch, sycamore, cottonwood, gum, bois d'arc, and chinaberry.

T. 6 S., R. 14 E.—This township is largely composed of gently rolling wooded land, with some prairies in central and western portions. The timber consists of the different species of oak, elm, ash, sycamore, cottonwood, bois d'arc, gum, walnut, hickory, pecan, hackberry, and mulberry.

T. 7 S., R. 14 E.—With the exception of a strip of prairie through the center, this township is timbered with oak, ash, elm, and hickory, with some cottonwood and sycamore in the lowlands.

T. 8 S., R. 14 E.—The bottom land of Red River is covered with a dense growth of cottonwood, sycamore, elm, ash, walnut, bois d'arc, mulberry, and hackberry timber, with undergrowth of briers.

T. 5 S., R. 15 E.—There is some prairie in the southeast, and also a few small open areas in the southwest corner. The remainder of the township is heavily timbered with the various species of oak, ash, elm, hickory, walnut, pecan, black gum, sycamore, sassafras, cottonwood, and bois d'arc.

T. 6 S., R. 15 E.—There is some prairie in the eastern side. The remainder of the township is heavily timbered with the various species of oak, elm, ash, sycamore, cottonwood, bois d'arc, walnut, hickory, and hackberry.

T. 7 S., R. 15 E.—The southern portion of this township is Red River bottom land. The remainder of the township is rolling timbered land covered with post oak, black-jack, elm, and hickory.

T. 8 S., R. 15 E.—The timber consists of oak, ash, elm, hickory, pecan, hackberry, walnut, and cottonwood, of little value commercially.

T. 5 S., R. 16 E.—The central and northern parts of this township are covered with oak, ash, elm, and hickory. The remainder is prairie.

T. 6 S., R. 16 E.—The southern portion of this township is heavily timbered with scrub oak, hickory, elm, and considerable undergrowth.

T. 7 S., R. 16 E.—The timber consists of oak, ash, hickory, walnut, pecan, sycamore, and cottonwood, of little value commercially.

T. 8 S., R. 16 E.—The timber in this small fractional township consists of oak, ash, elm, hickory, and cottonwood.

Townships 5–8 South, Ranges 17–20 East.

T. 5 S., R. 17 E.—Timber on the upland is oak and hickory. In the bottom there is oak, elm, ash, walnut, pecan, sycamore, gum, holly, bois d'arc, and hickory.

T. 6 S., R. 17 E.—This township is about equally divided between prairie and timbered land.

T. 7 S., R. 17 E.—The sandy ridges in the northern part of the township are covered with a fairly large-size growth of oak and hickory timber, while in the bottom is found oak, hickory, elm, ash, walnut, pecan, hackberry, cottonwood, and bois d'arc timber.

T. 8 S., R. 17 E.—Timber is cottonwood, oak, ash, elm, pecan, hickory, walnut, and bois d'arc, with dense undergrowth.

T. 5 S., R. 18 E.—All wooded. Ash, sycamore, elm, and gum grow along the Kiamichi River and Spencer Creek, while on the rolling land oak and hickory grow to large size. The former is of commercial value, while the latter is fit only for fuel.

T. 6 S., R. 18 E.—Fertile bottom lands lie along Salt Creek and Kiamichi River, with a valuable and extensive growth of white oak, ash, hickory, and bois d'arc.

T. 7 S., R. 18 E.—Nearly all wooded.

T. 8 S., R. 18 E.—The timber consists of oak, ash, elm, cottonwood, sycamore, and hackberry.

T. 5 S., R. 19 E.—The timber which covers the township is of little value, consisting of scrub oak, hickory, and some pine.

T. 6 S., R. 19 E.—This township is composed of rolling wooded land, with the exception of about one-fourth, which is prairie, with scattering trees and thickets of bois d'arc and elm. The timber consists of oak, hickory, elm, and bois d'arc, with some pine, most of which is of good quality.

T. 7 S., R. 19 E.—This township is heavily timbered with oak, ash, elm, bois d'arc, hickory, gum, and maple. Sycamore and cottonwood grow in the bottom lands.

T. 8 S., R. 19 E.—This area is all timbered.

T. 5 S., R. 20 E.—All wooded.

T. 6 S., R. 20 E.—This township is a little more than one-half timbered, the prairie lying in the southern portion, and is dotted with thickets of haw and bois d'arc and scattering elm trees. The timber consists of oak, pine, holly, and hickory, and is of fair quality, the pine and oak being suitable for lumber.

T. 7 S., R. 20 E.—The timber of this township consists of oak, ash, elm, cottonwood, and sycamore.

TOWNSHIPS 5–8 SOUTH, RANGES 21–24 EAST.

T. 5 S., R. 21 E.—The township is all timber land, consisting of oak, pine, elm, ash, and walnut of little commercial value.

T. 6 S., R. 21 E.—More than three-fourths of the township is covered with oak and hickory timber of little value commercially.

T. 7 S., R. 21 E.—The timber in this township consists of bois d'arc, elm, sycamore, ash, oak, hickory, and cottonwood.

T. 8 S., R. 21 E.—This fractional township contains level bottom land with scattering timber.

T. 5 S., R. 22 E.—All wooded; the timber consists of scrub oak and pine and some cypress.

T. 6 S., R. 22 E.—All wooded; the principal timber is pine, elm, hickory, gum, and sycamore.

T. 7 S., R. 22 E.—This township contains rolling wooded land, except the northwest portion, extending down to Red River bottom. The timber is scrub oak and small hickory.

T. 8 S., R. 22 E.—The township is well timbered with oak, elm, ash, sycamore, hackberry, hickory, and walnut, the latter only being of commercial value.

T. 5 S., R. 23 E.—All wooded timber is or a scrubby growth and consists of pine, hickory, and oak on the uplands and a few ash, elm, and sycamore in the bottoms.

T. 6 S., R. 23 E.—The entire township is covered with oak, hickory, sweet gum, ash, pine, maple, and sycamore timber; the white oak, which is found along the rivers, being of good quality and of commercial value.

T. 7 S., R. 23 E.—Nearly all wooded. The southern and western parts of this township are gently rolling, covered with oak and hickory timber. The bottom land is fertile and covered with a dense growth of ash, elm, oak, gum, maple, and hickory, with undergrowth of haw and bois d'arc.

T. 8 S., R. 23 E.—Nearly all wooded land.

T. 5 S., R. 24 E.—Township is all wooded, the principal timber being oak, pine, and hickory.

T. 6 S., R. 24 E.—The timber of this township, which covers it, is of a scrubby growth and of no commercial value, and consists of pine, oak, and hickory, with some sweet gum and elm.

T. 7 S., R. 24 E.—This township is entirely wooded and the timber consists of oak, hickory, elm, black and sweet gum, maple, and sycamore, but not of good quality.

T. 8 S., R. 24 E.—The timber is principally oak and hickory and is found throughout the township.

Townships 5–8 South, Ranges 25–27 East.

T. 5 S., R. 25 E.—The entire township is heavily timbered with oak, pine, and hickory, with some underbrush along creeks and branches. This timber is of poor quality, fit only for fuel and fences.

T. 6 S., R. 25 E.—With the exception of the small area in cultivation, this township is heavily wooded. Pine, oak, and hickory are found in abundance. Some of the pine in the eastern part is of large growth.

T. 7 S., R. 25 E.—The timber which covers the township consists of pine, oak, elm, hickory, holly, ash, sycamore, and bois d'arc.

T. 8 S., R. 25 E.—This township is nearly level, covered with oak and hickory timber. The timber is of fair quality for fencing and fuel. Along the creeks in the northern part of the township can be found some scattering elm, gum, and alder.

T. 5 S., R. 26 E.—Oak, hickory, and pine timber are found throughout the township.

T. 6 S., R. 26 E.—The timber consists of pine, oak, black-jack, sweet gum, hickory, hackberry, and black gum. A sawmill is located at Eagletown.

T. 7 S., R. 26 E.—Nearly all wooded.

T. 8 S., R. 26 E.—This township is covered with oak, hickory, and pine timber, the latter being valuable. The best quality of pine is found in the southern part of the township. There is a sawmill located on the second standard parallel between sections 5 and 32.

T. 5 S., R. 27 E.—The timber covers this entire fractional township and consists of oak, pine, and hickory, the pine alone being of much value.

T. 6 S., R. 27 E.—The timber consists of oak, hickory, and pine, some of the latter being merchantable.

T. 7 S., R. 27 E.—The timber on the south side of Little River consists of species of oak and hickory, and on the north side pine in addition to the above-named trees.

T. 8 S., R. 27 E.—This fractional township is covered with heavy timber of oak and pine, the pine being valuable commercially.

TOWNSHIPS 9–11 SOUTH, RANGES 23–27 EAST.

T. 9 S., R. 23 E.—This township contains almost level-bottomed timber land, consisting of cottonwood, sycamore, ash, elm, hickory, bois d'arc, oak, and willow.

T. 9 S., R. 24 E.—All wooded. The timber consists of oak, elm, cottonwood, ash, bois d'arc, sycamore, and willow.

T. 10 S., R. 24 E.—All wooded. The timber is willow, elm, cottonwood, and bois d'arc, of no value commercially.

T. 9 S., R. 25 E.—The timber, which is scattered over almost the entire fractional township, consists principally of oak and hickory, with dense thickets of haw and briers along water courses.

T. 10 S., R. 25 E.—The timber of this fractional township is oak, ash, elm, cottonwood, bois d'arc, sycamore, and willow.

T. 9 S., R. 26 E.—This area is covered with a heavy growth of oak, pine, and hickory.

T. 10 S., R. 26 E.—The timber consists of cottonwood, oak, ash, elm, bois d'arc, and sycamore.

T. 9 S., R. 27 E.—The northern half of this township is covered with a growth of timber, consisting of pine, oak, hickory, and sweet gum, while there is little timber of value in the southern part.

T. 10 S., R. 27 E.—The timber consists of oak, ash, gum, elm, bois d'arc, cottonwood, and willow.

T. 11 S., R. 27 E.—Timber here is ash, sycamore, and bois d'arc.

TOWNSHIPS 1–4 NORTH, RANGES 8–12 EAST.

T. 1 N., R. 8 E. (*Choctaw Nation*).—This township is chiefly prairie and heavily timbered bottom land. The bottoms are rich and would make good farming land, if cleared and improved. There is considerable fine timber along the creeks, consisting of oak, elm, ash, bois d'arc, pecan, walnut, hickory, and cottonwood.

T. 2 N., R. 8 E. (*Choctaw Nation*).—This township is partly prairie land. The timber is of little value except for fuel.

T. 3 N., R. 8 E. (*Choctaw Nation*).—The township is partly wooded. The timber is small and valuable chiefly as fuel.

T. 4 N., R. 8 E. (*Choctaw Nation*).—The township is almost entirely wooded. The timber is of inferior size and of little value except for fuel.

T. 1 N., R. 9 E.—The township is partly wooded, the timber consisting of various kinds of oak (post oak predominates), hickory, and elm. On the bottom lands are ash, hackberry, bois d'arc, and locust. With few exceptions the ridges are covered with post and black oak. The undergrowth of brier and vines on the bottom lands is dense.

T. 2 N., R. 9 E.—The surface is rolling and broken, except in the western part, where there is some bottom land along Leader Creek. The eastern and western parts are timbered and the central part is generally prairie.

T. 3 N., R. 9 E.—The southern portion is rolling and hilly, while through the central portion there extends from east to west a range of high hills, rocky, broken, and covered with timber of no value except for fuel. There is very little prairie in the township.

T. 4 N., R. 9 E.—Township is about two-thirds timbered.

T. 1 N., R. 10 E.—About one-fifth is timbered. The principal kinds of timber are different species of oak; together with hickory and elm.

T. 2 N., R. 10 E.—About one-half of this township is prairie and the balance is wooded. The timber is principally oak and hickory, with elm along the creeks; it is of little use except for fencing and firewood.

T. 3 N., R. 10 E.—This township consists of sandy ridges, rolling prairie, rocky hills, and bottom land. The greater part is well wooded with the exception of three or four sections in the southwestern part. The timber is mainly oak and hickory, with ash, elm, sycamore, and cottonwood in the bottoms and a little pine on the hills in the northern part.

T. 4 N., R. 10 E.—Land partly timbered, surface rolling and broken; covered with small hickory and oak timber. Oak, ash, elm, and other kinds of timber are found along the streams. At Guertie, in section 7, there is a saw and planing mill.

T. 1 N., R. 11 E.—Contains about equal portions of prairie and wooded land. The timber is inferior in size, very little of it having any value except for fuel. The principal species of timber on the uplands are oak and hickory; oak, hickory, ash, elm, and bois d'arc grow in the creek bottoms.

T. 2 N., R. 11 E.—The surface consists of gently rolling prairie, level creek bottoms, and a few timbered ridges. The timber along the streams consists of oak, elm, birch, ash, and hickory. The hills are thinly covered with post oak and black-jack.

T. 3 N., R. 11 E.—Covered with a light growth of oak and hickory.

T. 4 N., R. 11 E.—Nearly all rolling wooded land. Timber on the high land consists of oak and hickory, small and of poor quality.

Sycamore, elm, ash, pecan, and other kinds of timber are found along the creeks.

T. 1 N., R. 12 E.—Surface partly level and partly mountainous. Ash, oak, elm, hickory, walnut, and other kinds of timber are found along Boggy Creek and scattered along its branches.

T. 2 N., R. 12 E.—About one-half is rolling wooded land. The timber, consisting of oak, hickory, elm, and ash, is fairly good along streams, but of an inferior quality on uplands.

T. 3 N., R. 12 E.—The timber is mostly oak.

T. 4 N., R. 12 E.—The northeastern part is covered with oak, ash, hickory, and elm timber.

TOWNSHIPS 1–4 NORTH, RANGES 13–16 EAST.

T. 1 N., R. 13 E.—Parallel sandstone ridges, from 200 to 500 feet in height, covered with timber, cross this township. These ridges have some fairly valuable post oak, useful for cross-ties, and some good pine. The timber consists of species of oak, pine, hickory, elm, sycamore, hackberry, bois d'arc, mulberry, willows, walnut, black gum, and coffee bean. The oak timber is being cut for railroad ties and shipped from the nearest railroad stations. Pine is being cut for lumber.

T. 2 N., R. 13 E.—Contains mountain, hill, prairie, and rich valley land. Pine Mountain, a mass of sandstone (the strata being tilted), stands some 400 or 500 feet above the valleys and occupies most of the southeastern half of the township. Most of the timber in the township is inferior; the species are pine, oak, hickory, ash, and elm.

T. 3 N., R. 13 E.—Contains about one-third prairie and two-thirds wooded land.

T. 4 N., R. 13 E.—About four-fifths prairie, which is gently rolling, covered with grass and scattering trees. An admirable grazing country. The timber is confined to the eastern range of sections and the courses of creeks. It is worked over for railroad ties and the best trees have been cut out. Various kinds of oak, hickory, and elm are found on the uplands, and in the lowlands the same, with the addition of ash, walnut, and bois d'arc.

T. 1 N., R. 14 E.—About one-third prairie. A range of steep wooded hills, about 400 feet above the valley, divides it from southwest to northeast. Magee Creek bottom is covered with dense under growth and timber, and the hills are covered with pine and post oak.

T. 2 N., R. 14 E.—Mountainous, with some prairie and bottom land along Brushy Creek and its tributaries. The timber in the mountains is pine, post oak, and black jack, and in the bottoms, oak, hickory, ash, gum, elm, cherry, walnut, and dogwood.

T. 3 N., R. 14 E.—Prairie, with a few hills in the northern and southern parts covered with timber of oak and elm.

T. 4 N., R. 14 E.—Consists of rolling and hilly land, well timbered and watered, with considerable prairie in the western part. The timber is red oak, post oak, black oak, and hickory, with the addition in the bottoms of sycamore, elm, walnut, black gum, and bois d'arc.

T. 1 N., R. 15 E.—The northeastern and southern portions are mountainous, rocky, and broken. The mountains are covered with a growth of pine, oak, and hickory. The soil of the creek bottoms is rich, covered with a dense undergrowth of green briers and vines and timber of oak, ash, elm, walnut, and sycamore.

T. 2 N., R. 15 E.—Covered with a heavy growth of timber, consisting of oak, sycamore, elm, ash, hickory, and pine.

T. 3 N., R. 15 E.—The Pine Mountains extend in a northeast-southwest direction through the southern portion of the township. These mountains are not so high as those in the townships to the south, but like them are covered with timber of pine, oak, and hickory. Timber in creek bottoms consists of birch, gum, pecan, walnut, elm, hickory, oak, and bois d'arc.

T. 4 N., R. 15 E.—The ridges and hills in this township are rough, broken, and stony, covered with scrub oak, hickory, and undergrowth, while sycamore, birch, ash, elm, bois d'arc, and water oak are found in the lowlands.

T. 1 N., R. 16 E.—Nearly all mountainous, rocky, and broken, and for the most part covered with pine timber, some of which is of value.

T. 2 N., R. 16 E.—Mountainous ridges which are covered with timber of oak, hickory, and pine. Considerable lumbering has been done and most of the best pine has been culled.

T. 3 N., R. 16 E.—Mountainous in the northern and southern parts, and rolling and rocky in the central. In the mountains pine, oak, and hickory predominate. Some lumbering has been done and most of the pine has been culled.

T. 4 N., R. 16 E.—Timber in this township consists of oak, elm, hickory, and pine.

Townships 1–4 North, Ranges 17–20 East.

T. 1 N., R. 17 E.—Entirely wooded.

T. 2 N., R. 17 E.—Rocky, sandstone ridges and mountains, which are wooded. There is some ash, elm, hickory, and hackberry timber along the creeks.

T. 3 N., R. 17 E.—Rough and mountainous and mostly timbered, there being but a small strip of prairie along the northern portion. The timber is pine and oak, and some of the pine is valuable for lumber, but very difficult to get out, owing to the broken condition of the land.

T. 4 N., R. 17 E.—Partly timbered.

T. 1 N., R. 18 E.—Entirely wooded, the timber consisting of oak, pine, elm, ash, hickory, sycamore, gum, and cottonwood.

T. 2 N., R. 18 E.—Contains rolling, level, and mountainous wooded land. The timber in bottoms is oak, ash, elm, sycamore, hickory, and hackberry. Pine is also found in mountainous portions of the township.

T. 3 N., R. 18 E.—All timbered and very nearly all mountainous. At one time well covered with a fine growth of pine timber, which is rapidly being cut and will soon be exhausted. Pine, oak, and hickory are found in the township.

T. 4 N., R. 18 E.—Wooded, but there is no timber of any value in the township.

T. 1 N., R. 19 E.—All wooded and, excepting the northwestern portion, all mountainous. Sweet gum, oak, sycamore, elm, and hackberry are the principal trees in the bottom, and oak, hickory, and pine on the mountains.

T. 2 N., R. 19 E.—Partly wooded. There is a large planing mill in the town of Tuskahoma.

T. 3 N., R. 19 E.—Wooded. The northern part is very rough and broken by Potato Hill Mountains, which are covered with loose sandstone, and oak, pine, and hickory timber.

T. 4 N., R. 19 E.—The timber consists of oak, hickory, and pine, the latter being far the most valuable, although almost inaccessible.

T. 1 N., R. 20 E.—The timber of this township consists of pine, oak, and hickory, while in the Kiamichi Valley is found elm, ash, sycamore, dogwood, etc. Some of the pine and oak is of value for milling purposes.

T. 2 N., R. 20 E.—Entirely wooded.

T. 3 N., R. 20 E.—In the southern part of this township are the Potato Hill Mountains, very rough and broken, covered with oak and pine timber. There is very little timber of any commercial value.

T. 4 N., R. 20 E.—Mountainous and covered with large sandstone bowlders. The timber is black jack, hickory, and pine.

Townships 1–4 North, Ranges 21–24 East.

T. 1 N., R. 21 E.—This township is covered with a heavy growth of oak, pine, and hickory timber.

T. 2 N., R. 21 E.—Nearly all wooded. The southern part of the township is mountainous and covered with oak, pine, and hickory timber.

T. 3 N., R. 21 E.—Partly wooded.

T. 4 N., R. 21 E.—Mountainous, covered with heavy oak, pine, and hickory timber. Some elm, gum, and walnut timber is found along the creeks. The principal occupation of the inhabitants is lumbering.

T. 1 N., R. 22 E.—Rough and broken, being made up of numerous mountainous ridges, which are covered with a heavy growth of oak, pine, and hickory timber.

T. 2 N., R. 22 E.—The principal timber is oak, pine, and hickory. The level land along the river is very rocky and barren, formerly timbered with pine, which has been cut.

T. 3 N., R. 22 E.—The principal timber is oak, ash, elm, and hickory.

T. 4 N., R. 22 E.—Rocky and mountainous, and heavily timbered with post oak, black jack, hickory, and pine, the best of which has been cut.

T. 1 N., R. 23 E.—Composed entirely of mountainous, timbered land, and of no value for timber, which is of oak, pine, and hickory.

T. 2 N., R. 23 E.—The timber in this township is pine, oak, elm, ash, gum, and hickory.

T. 3 N., R. 23 E.—The timber is principally oak and pine on the mountains, with cedar and gum in the bottom.

T. 4 N., R. 23 E.—A mountainous, wooded township, the timber being pine, oak, and hickory.

T. 1 N., R. 24 E.—Mountainous and rolling wooded land, the timber being pine, oak, and hickory.

T. 2 N., R. 24 E.—Covered with a heavy growth of pine, oak, and hickory timber, very little of which is fit for lumber. In addition to the timber mentioned, elm, ash, cedar, and ironwood are found in the bottoms.

T. 3 N., R. 24 E.—The extreme southern portion is in the valley, or bottom of the Kiamichi River. This valley is heavily timbered with oak, elm, walnut, gum, cedar, and hickory and, in places, dense underbrush. The remaining portion consists of mountains and foothills, rocky and wooded.

T. 4 N., R. 24 E.—Mountainous and very rough and broken, covered with a heavy growth of oak, pine, and hickory timber.

Townships 1–4 North, Ranges 25–27 East.

T. 1 N., R. 25 E.—This township is all timbered land.

T. 2 N., R. 25 E.—The timber in this township consists of pine, oak, elm, and hickory.

T. 3 N., R. 25 E.—The timber consists of oak, hickory, and pine, the pine being of commercial value. The township contains many sawmills.

T. 4 N., R. 25 E.—The township is well timbered with oak, pine, hickory, elm, sycamore, and walnut, with a dense undergrowth.

T. 1 N., R. 26 E.—This township is all timbered, the timber being pine, oak, and hickory.

T. 2 N., R. 26 E.—The timber comprises species of oak and hickory and a very poor quality of pine.

T. 3 N., R. 26 E.—The timber, which is of poor quality, consists of oak, hickory, and pine.

T. 4 N., R. 26 E.—The land is covered with a heavy growth of oak, hickory, and pine timber, some of which is of fair quality for lumber. There is a sawmill located in about the center of section 28, on the Black Fork of Poteau River.

T. 1 N., R. 27 E.—The timber in this township is principally oak, pine, and hickory.

T. 2 N., R. 27 E.—The timber is principally oak, pine, and hickory.

T. 3 N., R. 27 E.—The timber consists of oak, pine, and hickory, and some walnut, linden, and gum along the bottom.

T. 4 N., R. 27 E.—This township contains nothing but rough, rolling land, covered with oak, pine, and hickory timber.

TOWNSHIPS 5–8 NORTH, RANGES 5–8 EAST.

T. 5 N., R. 5 E. (Seminole Nation).—The surface is, with the exception of the Canadian River bottom, rolling, broken, and covered with a heavy growth of oak. The bottom is level and contains a growth of cottonwood, elm, ash, walnut, pecan, and oak.

T. 6 N., R. 5 E.—About one-half is timbered with oak and hickory, with some elm and ash along the creeks.

T. 7 N., R. 5 E.—The timber is oak on the upland, and oak and hickory in the creek bottom.

T. 8 N., R. 5 E.—The largest portion is wooded. The timber consists mainly of oak and hickory.

T. 5 N., R. 6 E. (Seminole Nation).—The northeast part is rough and covered with oak and hickory timber. The western part has small oak and hickory. The Canadian River bottom contains cottonwood, sycamore, oak, ash, elm, walnut, and a dense undergrowth of same and of briers and vines.

T. 6 N., R. 6 E.—The timber is small oak and hickory, except in the narrow creek bottoms, which have oak, ash, elm, pecan, walnut, cottonwood, and sycamore.

T. 7 N., R. 6 E.—The surface consists of broken and rolling land, three-fourths of which is covered with timber. Oak is the principal timber, with ash and pecan along Little River and Salt Creek.

T. 8 N., R. 6 E.—Generally low, broken ridges, which are covered with oak and hickory. The river and creek bottoms are covered with oak, elm, ash, pecan, cottonwood, sycamore, and walnut.

T. 5 N., R. 7 E. (Seminole Nation).—Oak and hickory cover the township except the river bottom, which has also elm, cottonwood, ash, sycamore, and hickory and a dense growth of briers and vines.

T. 6 N., R. 7 E.—This township is almost entirely wooded. The timber is principally post oak and various other species of oaks, hickory, ash, pecan, elm, cottonwood, sycamore, and hackberry.

T. 7 N., R. 7 E.—The surface is occupied by high ridges and deep ravines in the southern and western portions. The northeastern portion is rolling and contains open timber. Timber principally oak of poor quality.

T. 8 N., R. 7 E.—The surface is rolling and broken, and is entirely covered with timber. Oak and hickory are the principal trees.

T. 5 N., R. 8 E. (*Seminole Nation*).—Timber of good size and quality is found in abundance. On the uplands the various oaks and hickory abound; in the bottoms, oak, cedar, ash, elm, hickory, sycamore, and cottonwood, with underbrush near the river and creeks.

T. 6 N., R. 8 E.—The timber consists of oak, elm, walnut, and cottonwood; and along the river there is much underbrush.

T. 7 N., R. 8 E.—This township is about one-half prairie and one-half well timbered with black, red, and post oak, pecan, elm, ash, and hickory, the oak predominating.

T. 8 N., R. 8 E.—This township consists largely of wooded land, only about one-sixth being prairie. Many of the common varieties of trees are found, most of them being too small to be of any value except for fuel.

Townships 5–8 North, Ranges 9–12 East.

T. 5 N., R. 9 E.—The northern and eastern portions are rough and hilly and nearly all timbered with black-jack, post oak, and hickory. The Canadian River flows northeast through section 6, the bottoms of which are heavily timbered with cottonwood, oak, elm, ash, and some walnut.

T. 6 N., R. 9 E.—Cottonwood, elm, ash, walnut, and other kinds of timber are found along the Canadian River and other streams.

T. 7 N., R. 9 E.—The timber is principally scrubby post oak, black-jack, and hickory. The township is about equally divided between prairie and wooded land.

T. 8 N., R. 9 E.—Partly wooded. Oak, elm, hickory, sycamore, walnut, and ash are found in the bottoms, while oak and hickory prevail in the uplands.

T. 5 N., R. 10 E.—The land is rolling and covered with timber, consisting principally of oak, with some hickory, ash, walnut, and birch.

T. 6 N., R. 10 E.—Cottonwood, elm, ash, hickory, oak, walnut, and other kinds of timber are found along the Canadian River and the small streams.

T. 7 N., R. 10 E.—The township is about equally divided between wooded and prairie land. The timber consists principally of oak and hickory, and is of poor quality.

T. 8 N., R. 10 E.—This township is about equally divided between wooded and prairie land. The timber along the creeks is oak, hickory, walnut, and sycamore. On the uplands oak prevails.

T. 5 N., R. 11 E.—The timber of this township is valueless and consists of post oak and black-jack.

T. 6 N., R. 11 E.—The entire township is timbered, the ridges with oak and hickory, the bottoms with oak, hickory, elm, sycamore, cottonwood, willow, and cedar, with dense undergrowth of same, and of vines and briers.

T. 7 N., R. 11 E.—The timber on the hills and mountains is oak and hickory; besides these, sycamore, ash, elm, and walnut are found along the banks of the river.

T. 8 N., R. 11 E.—The timber is of poor quality and consists principally of various species of oak.

T. 5 N., R. 12 E.—This area consists mainly of rocky ridges and creek bottoms. The timber on the hills is of scrubby oak and hickory, with a small amount of pine, but the bottom lands are heavily wooded with oak, hickory, elm, ash, and some walnut.

T. 6 N., R. 12 E.—Very rough and broken, covered with oak and scattered pine, except in the southeastern part, where there is some prairie.

T. 7 N., R. 12 E.—The surface consists of bottoms, sandy ridges, and rocky hills. The timber comprises scrub oak and hickory in the uplands; and in the bottoms, oak, hickory, elm, ash, cottonwood, sycamore, and walnut, with dense undergrowth of same, together with vines and briers.

T. 8 N., R. 12 E.—This area is well wooded with oak and hickory in upland and oak, elm, ash, cottonwood, walnut, and dense undergrowth in bottoms.

Townships 5–8 North, Ranges 13–16 East.

T. 5 N., R. 13 E.—Partly wooded.

T. 6 N., R. 13 E.—Elm, ash, walnut, mulberry, sycamore, and the several kinds of oak grow along the streams, while the mountains are covered with oak and hickory.

T. 7 N., R. 13 E.—The principal timber is oak and hickory, but in the bottom lands oak, hickory, walnut, ash, sycamore, elm, and mulberry are found.

T. 8 N., R. 13 E.—The different species of oak, with some hickory, are found on the mountains and ridges, while the bottoms along the river are well wooded with cottonwood, elm, walnut, sycamore, and some cedar. These varieties together with ash are found along Scipio Creek.

T. 5 N., R. 14 E.—Oak, hickory, and elm predominate, but ash, hackberry, willow, and sycamore are also found in the creek bottoms.

T. 6 N., R. 14 E.—The southeast and northwest portions are rolling prairies, with scattering timber. The remainder is rolling wooded land and creek bottoms. A large variety of timber is found in the lowlands; oak, elm, ash, hickory, and sycamore predominate. On the hills, however, oak and hickory are the only varieties existing.

T. 7 N., R. 14 E.—About one-half is wooded. There is very little good timber in the township, the principal trees being oak, hickory, and elm.

T. 8 N., R. 14 E.—Cottonwood, sycamore, ash, hackberry, willow, and elm are found along the river bottoms, while oak and hickory prevail on the higher land.

T. 5 N., R. 15 E.—This area is very rough and abounds in sandstone hills, which are covered with oak and hickory trees of inferior size.

T. 6 N., R. 15 E.—This township is rough and hilly, with some rolling prairie land in the southern and northeastern portions. It is well supplied with water and timber. The timber is of an inferior quality and embraces the different species of oak, as well as hickory, elm, ash, hackberry, walnut, and pine.

T. 7 N., R. 15 E.—With the exception of the prairie in the eastern and a little in the west-central portion, the land is all rough, rocky, and rolling wooded land. Small post-oak, black-jack, and hickory trees cover the uplands, while in the creek bottoms a great variety of species is found.

T. 8 N., R. 15 E.—The township is partly wooded. Oak and hickory are found on the uplands, and in the bottom lands oak, elm, ash, sycamore, walnut, and cottonwood.

T. 5 N., R. 16 E.—Partly wooded.

T. 6 N., R. 16 E.—The greater portion of the township is covered with small oak and hickory timber of little value, excepting for fuel and fencing.

T. 7 N., R. 16 E.—Most of the timber in this township consists of inferior-sized oak, of little value except for fuel and fencing.

T. 8 N., R. 16 E.—Oak, ash, elm, hackberry, cottonwood, sycamore, walnut, and pecan are found along the banks of Gaines Creek. The mountains are covered with post oak, black-jack, and hickory. A small sawmill is located in section 33 on Gaines Creek.

Townships 5–8 North, Ranges 17–20 East.

T. 5 N., R. 17 E.—The timber consists of oak, hickory, and pine, with ash and elm in the creek bottom. There is a small sawmill in section 14.

T. 6 N., R. 17 E.—The timber in this township is of no value.

T. 7 N., R. 17 E.—The mountainous portions of this township are covered with scrubby timber, mostly oak and hickory of little value.

T. 8 N., R. 17 E.—The timber in this township is of no particular value.

T. 5 N., R. 18 E.—Oak, elm, ash, walnut, sycamore, hackberry, maple, and hickory timber are found along the creek.

T. 6 N., R. 18 E.—This township is composed of rough and rocky ridges, covered with a growth of oak, pine, and hickory timber.

T. 7 N., R. 18 E.—The timber in this township is oak, pine, and hickory on ridges, with the addition of sycamore, ash, and elm in bottoms.

T. 8 N., R. 18 E.—Timber is oak, pine, and hickory on ridges; oak, pine, ash, elm, and hickory on rolling land.

T. 5 N., R. 19 E.—Composed of mountains, hills, and rolling and level lands, the mountains and hills being covered with a scrubby growth of oak and hickory; the rolling land in the central portion is covered with a fairly large sized growth of oak and hickory, and the level land, lying along the Fourche Maline, is covered with oak, hickory, elm, ash, and hackberry.

T. 6 N., R. 19 E.—The timber consists of pine, hickory, and different species of oak. There are three or four sawmills in the township, and the pine timber is being cut rapidly.

T. 7 N., R. 19 E.—All south of Sansbois Creek is wooded land, the timber being oak, pine, and hickory. Some of the pine is of value and is being cut and sawed by the several mills located in the township.

T. 8 N., R. 19 E.—The timber is of an inferior quality, being mostly scrub oak, black-jack, and hickory.

T. 5 N., R. 20 E.—The timber comprises oak, pine, and hickory on the upland, and, in addition, ash, elm, and sycamore in the bottoms.

T. 6 N., R. 20 E.—This township, lying in the Sansbois Mountains, contains a growth of oak, pine, and hickory timber.

T. 7 N., R. 20 E.—About two-thirds is mountainous land, covered with oak, pine, and hickory.

T. 8 N., R. 20 E.—The timber lies in the northwest, northeast, and southeast portions of the township, and consists of ash, elm, and hickory.

Townships 5–8 North, Ranges 21–24 East.

T. 5 N., R. 21 E.—Entirely timbered, with but little land under cultivation. Sycamore, elm, and ash are found in bottom lands, and post-oak and black-jack timber on higher ground.

T. 6 N., R. 21 E.—The timber consists of pine, oak, elm, ash, and hickory.

T. 7 N., R. 21 E.—There is a limited amount of good pine timber in this township, but the oak, etc., is of a scrubby nature and of no value.

T. 8 N., R. 21 E.—There is no timber of any value, the growth being mostly scrubby oak, except along the creek, where elm, ash, cottonwood, and sycamore are to be found.

T. 5 N., R. 22 E.—The pine timber is not very good, the best having been culled for mill purposes. The oak, elm, and ash in the bottoms is of a very good quality.

T. 6 N., R. 22 E.—The southern part of this township is mountainous, the northern nearly level, and contains timber consisting of oak, pine, and hickory.

T. 7 N., R. 22 E.—The timber consists of pine, oak, and hickory. The township is almost entirely wooded and contains but three or four farms. All of the most valuable timber has been cut and marketed.

T. 8 N., R. 22 E.—This township has a variety of timber, consisting of elm, ash, sycamore, walnut, pecan, hickory, pine, and the various species of oak.

T. 5 N., R. 23 E.—The timber is composed of elm, ash, walnut, hickory, and the different species of oak. There is also some pine, but most of this has been cut and sawed into lumber.

T. 6 N., R. 23 E.—Timber consists of pine, oak, elm, and hickory.

T. 7 N., R. 23 E.—The timber consists of oak, pine, elm, ash, pecan, hickory, and sycamore. The township is thinly settled, and those living in the northwest and southeast corners are engaged in logging.

T. 8 N., R. 23 E.—The surface is mountainous. There is a very fine growth of oak timber on the mountains. The timber consists of oak, pine, and hickory.

T. 5 N., R. 24 E.—The timber in the bottom is oak, elm, ash, pecan, sycamore, hackberry, cottonwood, birch, and hickory, with dense underbrush of briers and vines. Timber on uplands, oak, pine, and hickory.

T. 6 N., R. 24 E.—Entirely wooded.

T. 7 N., R. 24 E.—Timber in mountainous portion of this township is oak, pine, and hickory; along the creeks, ash and elm.

T. 8 N., R. 24 E.—Generally rolling and timbered, except in the northern portion, which is prairie.

Townships 5–8 North, Ranges 25–27 East.

T. 5 N., R. 25 E.—Entirely wooded. There is a sawmill in section 36 and also in section 26.

T. 6 N., R. 25 E.—Oak and hickory are found on the uplands and in the bottom lands oak, hickory, gum, elm, ash, and sycamore.

T. 7 N., R. 25 E.—Oak, hickory, walnut, elm, and sycamore are the principal trees to be found in the bottom lands of this township, with oak, hickory, and pine in the mountains.

T. 8 N., R. 25 E.—Partly wooded.

T. 5 N., R. 26 E.—Nearly all wooded.

T. 6 N., R. 26 E.—Nearly all wooded.

T. 7 N., R. 26 E.—This township contains two varieties of land—rolling timber and prairie in the eastern portion and level river bottom in the western. The bottoms are heavily timbered with oak, ash, elm, sycamore, and hickory.

T. 8 N., R. 26 E.—Partly wooded.

T. 5 N., R. 27 E.—All wooded.

T. 6 N., R. 27 E.—Sugarloaf Mountain, located in the northwest corner of section 4, is very steep and rocky and is covered with post-oak, pine, and black-jack timber. The timber throughout the township consists of hickory, oak, and pine of little value commercially.

T. 7 N., R. 27 E.—Partly wooded.

T. 8 N., R. 27 E.—Rolling and hilly, with level-topped ridges. The timber is found most extensively on the sides of the ridges and consists of oak, ash, hickory, elm, and black-jack.

Townships 9–12 North, Ranges 5–8 East.

T. 9 N., R. 5 E.—Post-oak, black-jack, red oak, and elm timber are found along all streams.

T. 10 N., R. 5 E.—Wooded along streams.

T. 11 N., R. 5 E.—This township is well timbered with post oak, ash, and hickory.

T. 9 N., R. 6 E.—This township consists of prairie, timber, and bottom lands.

T. 10 N., R. 6 E.—One-half prairie and the remainder wooded. The timber consists principally of oak, with some walnut and hickory along Turkey Creek.

T. 11 N., R. 6 E.—The southern portion of the township is equally divided between wooded and prairie lands. The timber on the river bottom is cottonwood, sycamore, pecan, ash, oak, elm, and walnut; on the upland, oak and hickory.

T. 12 N., R. 6 E.—Oak is the principal timber, but is small and valuable only as fuel.

T. 9 N., R. 7 E.—The land is almost entirely wooded, the principal timber being oak and hickory.

T. 10 N., R. 7 E.—This township is almost entirely covered with a thick growth of timber, several small prairies being found in the western portion. Post oak and black-jack are the principal trees.

T. 11 N., R. 7 E.—This township is almost entirely wooded. Post oak, black-jack, and hickory are found on the uplands, and elm, ash, sycamore, walnut, willow, and cottonwood, together with a dense growth of vines and briers, in the river bottoms.

T. 12 N., R. 7 E.—The eastern portion of this township is covered by a heavy growth of timber, principally oak and hickory. The western and northwestern portions have prairie areas.

T. 9 N., R. 8 E.—The surface of this township is varied. In the eastern and southern portions the land is rolling and level prairie, while in the northwest and central portions it is broken and thickly wooded. Oak and hickory are the principal trees.

T. 10 N., R. 8 E.—About one-fourth of the township in the eastern part is prairie, the remainder being wooded with a scrubby growth of black-jack and post oak, which has little value except as fuel.

T. 11 N., R. 8 E.—About equal portions of wooded and prairie land. The trees are oak, hickory, cottonwood, sycamore, and elm.

T. 12 N., R. 8 E.—The surface of this township is high and rolling and wooded, with the exception of scattered openings of prairie in the southern part. Oak and hickory is the principal timber.

Townships 9–12 North, Ranges 9–12 East.

T. 9 N., R. 9 E.—The township is divided about equally into wooded land and prairie. The timber consists of oak and hickory.

T. 10 N., R. 9 E.—About equally divided into wooded and prairie land. The bottom land is heavily timbered.

T. 11 N., R. 9 E.—Along the south and west portions of this township the timber is thick and first class, composed of oak, elm, ash, pecan, hickory, cottonwood, and sycamore, with dense underbrush along the river and creeks.

T. 12 N., R. 9 E.—About equally divided between prairie and wooded land.

T. 9 N., R. 10 E.—About three-fourths wooded.

T. 10 N., R. 10 E.—Covered with timber in nearly all parts. Along the North Fork of Canadian River the timber is very heavy and the underbrush dense.

T. 11 N., R. 10 E.—The southeast part is timbered with oak and hickory.

T. 12 N., R. 10 E.—Partly timbered with oak and hickory.

T. 9 N., R. 11 E.—Nearly all rolling wooded land. Oak, hickory, elm, ash, pecan, and walnut are found along the river and creek bottoms.

T. 10 N., R. 11 E.—The upland is covered with scrub oak, post oak, and hickory; the bottom land with oak, hickory, pecan, sycamore, cottonwood, and elm.

T. 11 N., R. 11 E.—Partly wooded. Scrub oak and hickory on the upland, and oak, hickory, ash, elm, cottonwood, and sycamore on the creek bottom land.

T. 12 N., R. 11 E.—About one-third wooded. The timber consists of oak, hickory, and elm.

T. 9 N., R. 12 E.—Largely rolling prairie, with strips of timber on the east and northwest, consisting of oak and hickory.

T. 10 N., R. 12 E.—Occupied by numerous rocky ridges which are covered with a heavy growth of post-oak and black-jack timber.

T. 11 N., R. 12 E.—The southern and central portions of this township consist of rolling prairie and open timbered land. In the northern portion are small ridges covered with scrub oak. Oak and hickory are the principal trees found.

T. 12 N., R. 12 E.—The northwestern part is principally prairie; the remainder is covered with small oak and hickory. In the bottom, along Montezuma Creek, there is a thick growth of oak, elm, ash, and some pecan.

TOWNSHIPS 9–12 NORTH, RANGES 13–16 EAST.

T. 9 N., R. 13 E.—This township is nearly all wooded, although it contains many small prairies. The timber is oak, elm, hickory, walnut, and sycamore.

T. 10 N., R. 13 E.—The northern and western parts are open timber and rolling prairies. Oak, elm, ash, walnut, pecan, hickory, sycamore, hackberry, and cottonwood are found in the river bottom land, while only oak and hickory grow on the hills.

T. 11 N., R. 13 E.—The eastern portion of this township is rolling land, largely prairie, with timber along the creeks. The western part is hilly and partly timbered with oak and hickory.

T. 12 N., R. 13 E.—The eastern portion of this township is river bottom land, while rolling prairie and timber lands are found in the central portion. The bottom land along Deep Fork of Canadian River is covered with a heavy growth of oak, elm, ash, sycamore, pecan, cottonwood, poplar, and walnut, together with a dense undergrowth. The surface of the western portion is rolling and generally covered with oak and hickory of inferior quality.

T. 9 N., R. 14 E.—The southern portion of this township is covered with a dense growth of underbrush, the timber consisting of oak, ash, elm, sycamore, dogwood, hickory, and poplar; the middle portion is covered with a dense growth of black-jack oak, and the northern portion is mountainous and partly covered with a heavy growth of hickory and oak.

T. 10 N., R. 14 E.—Elm, ash, cottonwood, and walnut timber is found along the North Fork of the Canadian; oak and hickory on the higher ground.

T. 11 N., R. 14 E.—Sycamore, ash, walnut, and cedar timber is found along the river; oak and hickory, with scattering pine, on the higher ground. The timber is generally of good quality, there being some fine cedar in bottoms along the river.

T. 12 N., R. 14 E.—This township is about equally divided between wooded and open land. The southern half is well timbered, while the northern part is high, rolling prairie.

T. 9 N., R. 15 E.—Cottonwood, sycamore, ash, and walnut are found along Mill Creek and the Canadian River; oak and hickory on higher ground.

T. 10 N., R. 15 E.—This township is of rolling prairie, with timber along the water courses. The northwest portion is rocky and hilly and covered with oak and hickory timber. In the lowlands the timber comprises oak, hickory, elm, ash, walnut, sycamore, cottonwood, and pecan.

T. 11 N., R. 15 E.—This township is partly wooded and partly prairie. The principal kinds of timber are oak, elm, ash, and hickory. Numerous other varieties occur less abundantly.

T. 12 N., R. 15 E.—Deep Fork of the Canadian flows through the southern part of the township, and along this river bottom grow oak, elm, ash, hickory, hackberry, cottonwood, willow, sycamore, locust, pecan, redwood, walnut, dogwood, spicewood, persimmon, red haw, ironwood, plum, birch, and a dense undergrowth.

T. 9 N., R. 16 E.—Ranging from flat river bottom to rolling, broken wooded land, this township contains oak, elm, ash, sycamore, persimmon, walnut, hackberry, cottonwood, and hickory, together with a dense undergrowth in the bottoms. The northwestern and southeastern portions of the township are occupied by uplands, containing a growth of the scrub oak and hickory.

T. 10 N., R. 16 E.—This area is almost entirely wooded, the surface being rolling and level. The rolling land is timbered with oak and hickory, while the bottom land is heavily timbered with oak, cottonwood, sycamore, ash, elm, hickory, willow, pecan, and walnut.

T. 11 N., R.16 E.—This township is about half wooded. The rolling land is timbered with oak, hickory, ash, hackberry, and the river bottoms with oak, ash, hackberry, sycamore, cottonwood, red bud, walnut, willow, and pecan.

T. 12 N., R. 16 E.—The extreme southern part is covered with a growth of oak, elm, ash, and hickory timber.

Townships 9–12 North, Ranges 17–20 East.

T. 9 N., R. 17 E.—The trees in this township are oak, elm, ash, hickory, pecan, hackberry, sycamore, cottonwood, willows, walnut, and bois d'arc.

T. 10 N., R. 17 E.—Oak, elm, walnut, cottonwood, and sycamore timber are found in the bottoms, hickory on the uplands.

T. 11 N., R. 17 E.—A small strip of timber extends northeastwardly into the township; the balance is prairie. The timber consists of scrub oak and hickory.

T. 12 N., R. 17 E.—Principally high, rolling prairie, with oak, elm, hickory, walnut, and ash timber on the creek bottom land.

T. 9 N., R. 18 E.—Partly wooded.

T. 10 N., R. 18 E.—The timber in this township consists of oak, elm, ash, hickory, hackberry, cottonwood, and sycamore.

T. 11 N., R. 18 E.—Rolling wooded and prairie lands, with ridges running from northwest to southeast which are covered with a good growth of oak and hickory.

T. 12 N., R. 18 E.—Rolling prairie and wooded land. Oak and hickory are the principal trees found.

T. 9 N., R. 19 E.—The principal timber of the township is oak, ash, hickory, elm, cedar, and walnut.

T. 10 N., R. 19 E.—The timber consists of oak, elm, ash, pecan, hickory, locust, walnut, cottonwood, and sycamore. A few scattering pine and cedar trees are found in the mountainous portions.

T. 11 N., R. 19 E.—Hills and ridges are in places covered with a dense growth of oak and hickory timber. The creek bottom land is also wooded except where cleared for farming.

T. 12 N., R. 19 E.—Partly wooded and partly open prairie. Trees found are elm, ash, cottonwood, various oaks, and hickory of good size.

T. 9 N., R. 20 E.—Partly wooded. Oak and hickory are the only kinds of trees found on the uplands, while in the bottoms oak, elm, ash, pecan, walnut, hackberry, cherry, birch, and sycamore are found.

T. 10 N., R. 20 E.—Cottonwood, sycamore, hackberry, hickory, elm, ash, walnut, and oak grow in this area.

T. 11 N., R. 20 E.—The southern portion of this township is wooded. The trees are oak, ash, elm, pecan, walnut, hickory, sycamore, and cottonwood.

T. 12 N., R. 20 E.—The timber in this township is composed of oak, elm, ash, hackberry, walnut, hickory, cottonwood, and sycamore.

Townships 9–12 North, Ranges 21–24 East.

T. 9 N., R. 21 E.—Nearly all rolling land and wooded except small areas in the southern and northwestern parts. Oak, ash, elm, and other kinds of trees are found along Sansbois Creek and its branches, and oak and hickory on the uplands.

T. 10 N., R. 21 E.—The timber consists principally of oak and hickory of an inferior quality. There is some ash, elm, and sycamore on the streams.

T. 11 N., R. 21 E.—The timber found along the river bottoms consists of elm, ash, and walnut.

T. 12 N., R. 21 E.—The northern portion is rolling upland covered with loose stone and oak and hickory timber. The remaining portion is low and level bottom land, with sandy soil covered with a dense growth of cottonwood, oak, elm, ash, pecan, willow, walnut, and hackberry.

T. 9 N., R. 22 E.—The timber is oak, ash, elm, hickory, hackberry, and walnut.

T. 10 N., R. 22 E.—The timber in this township comprises oak, ash, elm, hickory, walnut, pecan, sycamore, and hackberry, with much undergrowth.

T. 11 N., R. 22 E.—The timber is oak, ash, elm, hickory, hackberry, walnut, sycamore, pecan, and cottonwood. Sand Town, a small sawmill camp, is located in section 17, on left bank of Arkansas River.

T. 12 N., R. 22 E.—Generally wooded, except in the central and southeastern portions. Many varieties of trees are found within the township, though oak and hickory predominate.

T. 9 N., R. 23 E.—This township contains mountainous, rolling, and level land, partly wooded and some prairie. The timber is oak, ash, elm, and hickory.

T. 10 N., R. 23 E.—Partly wooded.

T. 11 N., R. 23 E.—Oak, elm, ash, pecan, walnut, and other trees are found along the streams.

T. 12 N., R. 23 E.—The timber for the most part is oak and hickory, with some walnut, sycamore, etc., in creek bottoms.

T. 9 N., R. 24 E.—This area contains high, rolling prairie and wooded lands. The principal timber is oak, hickory, and elm.

T. 10 N., R. 24 E.—The township is heavily wooded in all but the southern part, which is prairie.

T. 11 N., R. 24 E.—The timber embraces oak, elm, hickory, and walnut.

T. 12 N., R. 24 E.—This township is in the northern two-thirds covered with a growth of oak and hickory, with a dense growth of underbrush.

TOWNSHIPS 9–12 NORTH, RANGES 25–27 EAST.

T. 9 N., R. 25 E.—The northern portion of this township lies in the Arkansas River bottom. This part and the eastern portion is heavily wooded. Timber consists of oak, hickory, hackberry, ash, hawthorn, sassafras, and persimmon.

T. 10 N.; R. 25 E.—The timber of this township comprises oak, hickory, and elm, with ash, cottonwood, and sycamore along rivers.

T. 11 N., R. 25 E.—Largely rolling timber land consisting of oak, hickory, and elm, with some mulberry, ash, and ironwood along the creeks.

T. 12 N., R. 25 E.—High, rolling timbered land. The principal timbers are oak, hickory, and elm.

T. 9 N., R. 26 E.—The land is covered with a dense growth of scrub oak, hickory, and elm.

T. 10 N., R. 26 E.—The timber in this area is oak, ash, elm, hickory, walnut, pecan, hackberry, and cottonwood.

T. 11 N., R. 26 E.—The timber in this township is oak, hickory, and elm.

T. 12 N., R. 26 E.—This township consists of high, rolling, wooded land, the timber being oak and hickory.

T. 9 N., R. 27 E.—The timber is oak, elm, ash, and hickory.

T. 10 N., R. 27 E.—Timber in this township is oak, ash, elm, hickory, pecan, locust, hackberry, cottonwood, walnut, and sycamore.

T. 11 N., R. 27 E.—The timber in this township is oak, hickory, ash, hackberry, elm, gum, cottonwood, and sycamore.

T. 12 N., R. 27 E.—The timber is oak, hickory, elm, ash, and gum.

Townships 13–16 North, Ranges 6–8 East.

T. 13 N., R. 6 E.—The northern part of this fractional township is prairie and the southern part is timbered with oak and hickory.

T. 14 N., R. 6 E.—Timber of this township is oak and hickory.

T. 15 N., R. 6 E.—About one-half of this fractional township is timbered with oak and hickory.

T. 13 N., R. 7 E.—The surface of this township is broken and hilly, and covered with a growth of oak, with small openings of prairie in the southwest. In addition to oak, elm, ash, cottonwood, walnut and sycamore grows along the creek bottoms.

T. 14 N., R. 7 E.—Nearly all wooded. The timber in the creeks and river bottoms is oak, hickory, pecan, ash, elm, and sycamore. The rolling land is covered with oak and hickory.

T. 15 N., R. 7 E.—With the exception of small openings of prairie scattered through the north and west, this township is covered with a growth of oak timber.

T. 16 N., R. 7 E.—Oak, ash, pecan, sycamore, and other kinds of timber are found along Little Deep Fork and Spring Creek. On the rolling land, oak and hickory prevail.

T. 13 N., R. 8 E.—This township is high, rolling land, with very little open country. The timber is principally oak, hickory, ash, elm, walnut, and black-jack.

T. 14 N., R. 8 E.—The surface is generally rolling, wooded land. Timber consists of oak, hickory, elm, ash, cottonwood, walnut, and pecan.

T. 15 N., R. 8 E.—This township is high, rolling land, heavily timbered.

T. 16 N., R. 8 E.—This township is high, rolling land, heavily timbered with the several species of oak and hickory.

Townships 13–16 North, Ranges 9–12 East.

T. 13 N., R. 9 E.—This township is, with the exception of a portion in the western part, almost entirely timbered. Oak, hickory, and ash are found in the higher portions, while elm, walnut, pecan, and sycamore, together with a dense growth of underbrush, are found along the banks of the creeks and in the bottom land along Deep Fork of the Canadian.

T. 14 N., R. 9 E.—This township, with the exception of a portion in the east and north, is almost entirely wooded. The uplands are covered by a heavy growth of oak and hickory, while the river and creek bottoms afford valuable timber, principally walnut, oak, sycamore, cottonwood, and elm.

T. 15 N., R. 9 E.—The uplands of this township are covered with a heavy growth of scrub oak and hickory of no value. The bottom lands along Little Deep Fork of the Canadian are covered with oak, elm, ash, walnut, willow, and sycamore.

T. 16 N., R. 9 E.—This township is almost entirely wooded. The uplands are covered with a heavy growth of scrub oak and hickory, while the creek bottom lands grow elm, ash, and pecan.

T. 13 N., R. 10 E.—There is prairie in the central part of this township, the remaining portion being rolling and broken wooded land. Oak, ash, pecan, cottonwood, elm, hickory, and walnut are found along the streams. The rolling timbered land is covered with a growth of oak and hickory.

T. 14 N., R. 10 E.—The southern portion of this township along Deep Fork of the Canadian is low and level and covered with a heavy growth of timber of oak, ash, elm, pecan, and sycamore. The rolling land is partly covered with a growth of scrub oak and hickory.

T. 15 N., R. 10 E.—Along the Deep Fork of the Canadian the land in this township is level and covered with a heavy growth of timber. The remaining portion is open and rolling timbered land. Oak, pecan, hickory, ash, and elm are the principal trees found.

T. 16 N., R. 10 E.—About half of this township is broken and rolling wooded land. Oak and hickory are the principal kinds of timber found.

T. 13 N., R. 11 E.—The timber in the eastern and southeastern portions is post oak, black-jack, and hickory of little value.

T. 14 N., R. 11 E.—This township is nearly level and two-thirds of it is covered with timber. Oak, black-jack, and hickory are found on the uplands; ash, elm, sycamore, walnut, pecan, and maple are found in the river bottoms.

T. 15 N., R. 11 E.—A portion of this township is covered with a heavy growth of oak, ash, and hickory.

T. 16 N., R. 11 E.—This township is nearly all wooded, with the exception of a few sections in the northern portion and the southeast corner. The timber embraces the different species of oak, together with ash, elm, hickory, pecan, and maple, all of which is inferior in size and of no marketable value.

T. 13 N., R. 12 E.—This township is principally rolling land, timbered with oak and hickory. Oak, elm, ash, hickory, walnut, cottonwood, sycamore, dogwood, cedar, and pecan grow on the bottom lands.

T. 14 N., R. 12 E.—This township is generally rolling land, timbered with oak and hickory on upland, and ash, elm, pecan, sycamore, and walnut in the river bottoms.

T. 15 N., R. 12 E.—This township contains chiefly rolling land, the timbered portions occuring in the southeast, which are broken and hilly. The timber consists almost entirely of oak and hickory of an inferior quality and of no commercial value.

T. 16 N., R. 12 E.—Small patches of timber are found along the creeks and branches.

Townships 13–16 North, Ranges 13–16 East.

T. 13 N., R. 13 E.—About one-half wooded. Sycamore, cottonwood, and elm may be found on the banks of the Deep Fork of the Canadian. Oak and hickory are found on the elevated parts.

T. 14 N., R. 13 E.—A line of scattering timber is found along the creeks of this township.

T. 15 N., R. 13 E.—Partly wooded. Oak, ash, elm, cottonwood, sycamore, walnut, and pecan timber is found in the creek bottoms; oak and hickory are found on some of the hills and ridges.

T. 16 N., R. 13 E.—About one-half wooded. The creeks are all skirted with oak, hickory, ash, elm, walnut, and pecan timber.

T. 13 N., R. 14 E.—With the exception of some timber in the southeast portion the whole township is open, rolling prairie. Oak, hickory, sycamore, and elm are the principal trees found.

T. 14 N., R. 14 E.—Nearly all prairie; there is some scattering timber in the northeastern portion, consisting of oak and pecan.

T. 15 N., R. 14 E.—This township is divided between rolling prairie and timbered ridges, about one-fourth in the northwestern part being wooded.

T. 16 N., R. 14 E.—Nearly all timbered; sycamore and elm are found along Snake Creek, remaining timber is principally oak and hickory.

T. 13 N., R. 15 E.—This township is entirely prairie with the exception of a small amount of timber in the southwestern part.

T. 14 N., R. 15 E.—This township is about three-fourths prairie and the balance wooded. The timber consists of oak, elm, hickory, and pecan and is found along Cane Creek.

T. 15 N., R. 15 E.—With the exception of timber along the streams, the whole of this township is open, rolling prairie. The timber is oak, ash, elm, and hickory.

T. 16 N., R. 15 E.—About one-third wooded. The timber on creeks and river bottoms is oak, elm, sycamore, ash, pecan, and walnut, while oak and hickory are found on the uplands.

T. 13 N., R. 16 E.—This township is entirely open prairie, save for a few patches of timber along the creeks.

T. 14 N., R. 16 E.—Timber is oak, hickory, elm, walnut, and sycamore along creeks.

T. 15 N., R. 16 E.—The timber is heavy on three-fourths of the township, and consists of oak, hickory, ash, cottonwood, sycamore, and walnut.

T. 16 N., R. 16 E.—Oak, ash, cottonwood, elm, sycamore, walnut, and other kinds of timber, with a dense undergrowth of same, and vines are found along the Arkansas River bottom lands.

TOWNSHIPS 13-16 NORTH, RANGES 17-20 EAST.

T. 13 N., R. 17 E.—The southeast corner of this township is timbered and small timber grows along the streams. The timber consists of oak, ash, elm, and hickory.

T. 14 N., R. 17 E.—Timber, consisting of oak, ash, elm, hackberry, and pecan, grows along Pecan Creek and other streams. There is also some oak and hickory in the northeast corner of township.

T. 15 N., R. 17 E.—There are numerous small creeks and branches throughout the township, along which is a good growth of oak, elm, pecan, hickory, and ash timber. The timber along the Arkansas River is an excellent quality of oak, elm, walnut, hackberry, hickory, sycamore, and cottonwood, some of the trees measuring 4 feet in diameter.

T. 16 N., R. 17 E.—This township is, with the exception of a little timber in the northern, southern, and northeastern parts, rolling prairie, with narrow belts of timber skirting the small creeks. The timber is oak, hickory, elm, walnut, pecan, sycamore, hackberry, and cottonwood.

T. 13 N., R. 18 E.—Timber in this township is oak, hickory, redbud, elm, walnut, and pecan.

T. 14 N., R. 18 E.—Very little timber in this township.

T. 15 N., R. 18 E.—There is a heavy growth of timber in the bottom land along the river, consisting of oak, elm, ash, hickory, pecan, walnut, persimmon, hackberry, mulberry, locust, redbud, sycamore, and cottonwood.

T. 16 N., R. 18 E.—This township, about two-thirds of which is wooded, contains rolling and level land. The timbers are oak, elm, ash, locust, hickory, hackberry, and mulberry.

T. 13 N., R. 19 E.—This area consists of hills, rolling and level prairie, river bottoms, and level and rolling wooded lands. The eastern portion is timbered except where cleared for cultivation. The timber is oak, elm, ash, hickory, pecan, walnut, sycamore, and cottonwood, is of a good quality, and in places very dense. The oak, walnut, and ash are suitable for lumber, and other varieties are of value only for fuel and fencing purposes. The western portion of the township is principally rolling prairie, with scattering oak, elm, and pecan timber along the creeks.

T. 14 N., R. 19 E.—The eastern portion of this township is level and gently rolling land, heavily wooded. The timber, consisting of oak, elm, ash, pecan, walnut, hickory, mulberry, hackberry, and sycamore, is very dense and contains an undergrowth of briars and vines.

The western portion of this township is for the most part high, rolling prairie land, somewhat hilly, with an occasional strip of oak and hickory timber.

T. 15 N., R. 19 E.—The township has a very heavy growth of timber, consisting of elm, ash, pecan, walnut, hickory, hackberry, mulberry, locust, redbud, wild plum, various oaks, and undergrowth.

T. 16 N., R. 19 E.—This township consists of rolling prairie and wooded land, while along the rivers are narrow bottoms. The timber is oak, ash, hickory, elm, and sycamore, and is found mostly in the river bottoms.

T. 13 N., R. 20 E.—The timber on the ridges is oak, pine, and hickory, and in the bottom land oak, ash, elm, pecan, walnut, elder, sycamore, hackberry, cottonwood, and hickory.

T. 14 N., R. 20 E.—This township contains broken land in the southeast and northwest, and gently rolling prairie and timber in the remainder. The banks of the Arkansas River are high and are heavily timbered with oak, elm, ash, walnut, sycamore, pecan, locust, hackberry, and cottonwood timber. The ridges are covered with oak and hickory.

T. 15 N., R. 20 E.—The Arkansas River is bordered by rich bottom land, covered with a heavy growth of timber and underbrush. Manard Bayou also flows through the township and is bordered by rich land, covered with a heavy growth of timber and underbrush. Timber on ridges is oak, elm, and hickory, and in bottoms oak, elm, ash, hickory, walnut, pecan, sycamore, hackberry, cottonwood, shittim, redbud, locust, elder, and mulberry.

T. 16 N., R. 20 E.—The timber in this township is oak and hickory on the uplands; oak, hickory, elm, ash, pecan, sycamore, walnut, and cottonwood along the river. The bottoms of the Grand River are narrow, heavily timbered, but subject to overflow.

TOWNSHIPS 13–16 NORTH, RANGES 21–24 EAST.

T. 13 N., R. 21 E.—Oak, hickory, and elm timber are found on the ridges, while ash, box elder, mulberry, sycamore, walnut, and hackberry are found on the river and creek bottoms.

T. 14 N., R. 21 E.—Well timbered with oak and hickory, and in the bottom lands with elm, ash, sycamore, and walnut.

T. 15 N., R. 21 E.—The timber consists of oak, elm, and hickory.

T. 16 N., R. 21 E.—Thickly wooded with oak, hickory, ash, elm, sycamore, walnut, and box elder, and a dense undergrowth.

T. 13 N., R. 22 E.—The timber is elm, oak, and hickory, with a little pine and cedar.

T. 14 N., R. 22 E.—The township is well wooded, the lowlands containing oak, ash, elm, sycamore, and hackberry, while on the highlands pine and cedar take the place of hackberry, sycamore, and elm.

T. 15 N., R. 22 E.—The principal timber is oak, elm, ash, hickory, and sycamore in the bottoms, and oak and hickory on the uplands.

T. 16 N., R. 22 E.—The timber is oak and hickory except in the bottom land, where elm, ash, sycamore, and hackberry are found.

T. 13 N., R. 23 E.—The timber is oak and hickory, with some elm, ash, and walnut in the bottom lands. There is a fine body of oak found along the ridges that is suitable for railroad ties.

T. 14 N., R. 23 E.—Well wooded, that on the elevated portions consisting of elm, hickory, and pine, and on the rolling land the same with the omission of pine.

T. 15 N., R. 23 E.—The upland in this township is very stony, covered with oak and hickory timber of a fair quality. The lowland is covered with oak, elm, ash, hickory, walnut, mulberry, hackberry, and sycamore, with underbrush of same.

T. 16 N., R. 23 E.—The bottom along Barren Fork is covered by a dense growth of oak, elm, ash, hickory, walnut, and sycamore. The ridges are covered with oak, pine, and hickory.

T. 13 N., R. 24 E.—Well wooded. The bottom land in this township is covered with oak, ash, elm, walnut, pecan, hickory, and underbrush and vines.

T. 14 N., R. 24 E.—Well timbered with oak and hickory, while in the bottom land is also found elm, ash, walnut, and sycamore.

T. 15 N., R. 24 E.—This township is made up of irregular hills and ridges, covered with a dense growth of oak, elm, and hickory timber.

T. 16 N., R. 24 E.—The land, with the exception of the narrow bottoms along Caney Creek, is covered with an abundant growth of oak, elm, ash, and pine timber.

Townships 13–16 North, Ranges 25–27 East.

T. 13 N., R. 25 E.—The entire area has a rolling and broken surface covered with a growth of oak, hickory, and scattering pine timber.

T. 14 N., R. 25 E.—The timber of this township is of fair quality and consists of oak and hickory, with some elm and ash in the bottoms.

T. 15 N., R. 25 E.—The timber in this township is of fine quality and consists of oak, hickory, and elm, with some scattering walnut and ash. There is a sawmill in section 20.

T. 16 N., R. 25 E.—The timber consists of oak and hickory, with some elm, ash, and pine.

T. 13 N., R. 26 E.—Oak and hickory cover the uplands in this township, while ash, elm, walnut, gum, and sycamore timber abound in the bottoms.

T. 14 N., R. 26 E.—The hills and canyons are covered with a heavy growth of oak, hickory, and elm timber. Along some of the creeks are found a few ash and walnut trees, and on some of the highest hills are a few scattering pines.

T. 15 N., R. 26 E.—The southern portion of this township is covered with oak and hickory timber. The northern part is covered with oak and hickory on the upland, and ash, elm, and walnut along the creeks.

T. 16 N., R. 26 E.—The timber of this township consists of oak, hickory, elm, pine, and some scattering walnut.

T. 13 N., R. 27 E.—Oak, pine, and hickory are found on the uplands, while the bottom land contains ash, elm, oak, hickory, and sycamore.

T. 14 N., R. 27 E.—This small fractional township is rolling and broken, covered with oak, elm, and hickory timber.

Townships 17–19 North, Ranges 7–12 East.

T. 17 N., R. 7 E.—Nearly all timbered. Oak and hickory are the principal trees found.

T. 18 N., R. 7 E.—This township is principally rolling land, timbered with a growth of oak and hickory on upland, and in bottom land with ash, elm, walnut, and cottonwood.

T. 19 N., R. 7 E.—Cottonwood, ash, cedar, and other kinds of timber are found along the Cimarron River and Lagoon Creek; oak and hickory on the higher ground.

T. 17 N., R. 8 E.—About one-sixth of this township is prairie, and the rest is covered with open oak and hickory timber.

T. 18 N., R. 8 E.—This township is principally rolling wooded land, timbered with oak, hickory, elm, ash, and walnut.

T. 19 N., R. 8 E.—Cedar, cottonwood, ash, and willow are found along the Cimarron River, and oak and hickory on the higher ground.

T. 17 N., R. 9 E.—Nearly all wooded; the principal timber along the creek is cottonwood and sycamore. The highlands are covered with different species of oak and some hickory.

T. 18 N., R. 9 E.—This township is timbered with oak of inferior quality.

T. 19 N., R. 9 E.—Cottonwood, ash, elm, and other kinds of timber are found along Salt Creek and the Cimarron River, and oak and hickory on higher ground. The area is almost entirely wooded.

T. 17 N., R. 10 E.—This township is divided into about one-fourth prairie and three-fourths wooded land. The timber consists of oak, ash, elm, and hickory.

T. 18 N., R. 10 E.—The township is wooded, except in a few open glades; the trees found are hickory, various species of oak, and, along the streams, walnut, birch, elm, and pecan.

T. 19 N., R. 10 E.—Cottonwood, ash, elm, walnut, and other kinds of timber are found along the Arkansas River, oak and hickory predominating on the higher ground. About four-fifths of the township is wooded land.

T. 17 N., R. 11 E.—This township is nearly all wooded land. The timber is principally oak and hickory of small growth.

T. 18 N., R. 11 E.—This township is more than three-fourths wooded. The timber comprises oak and hickory of small growth.

T. 19 N., R. 11 E.—Cottonwood, ash, elm, walnut, and other kinds of timber are found along the Arkansas River bottom lands, and oak and hickory on higher ground. Some of the timber is good and of value commercially.

T. 17 N., R. 12 E.—The western portion of this township is rough and broken and made up of a succession of ridges, covered with a scrubby growth of black-jack, post oak, and hickory.

T. 18 N., R. 12 E.—Species of oak and hickory are found on the upland, with sycamore, ash, elm, walnut, and pecan in the bottom land.

T. 19 N., R. 12 E.—Cottonwood, sycamore, oak, ash, walnut, pecan, elm, and hickory are found in the river bottoms, with oak and hickory on the hills and rolling land.

T. 20 N., R. 12 E.—Timber in this township consists of small oak, hickory, elm, pecan, and locust.

TOWNSHIPS 17–20 NORTH, RANGES 13–16 EAST.

T. 17 N., R. 13 E.—Oak, elm, ash, locust, walnut, birch, cottonwood, sycamore, and willow are found along the Arkansas River and in the bottom lands throughout the township.

T. 18 N., R. 13 E.—Along the valley of the Arkansas River and Polecat Creek are found oak, ash, elm, hickory, walnut, pecan, sycamore, and cottonwood timber. The balance of the township, except a prairie in the northeast part, is covered with black-jack and hickory.

T. 19 N., R. 13 E.—This township consists of rolling prairie and timbered land.

T. 20 N., R. 13 E.—Ash, oak, elm, hickory, sycamore, pecan, and hackberry timber is found along the creek bottoms.

T. 17 N., R. 14 E.—Timber in bottom land consists of oak, elm, ash, walnut, pecan, hickory, sycamore, hackberry, shittim, and gum; on the uplands, oak and hickory.

T. 18 N., R. 14 E.—Timber is found along the creeks, consisting of oak, walnut, sycamore, and elm.

T. 19 N., R. 14 E.—Only scattering timber in this township.

T. 20 N., R. 14 E.—The land bordering Bird Creek and Mingo Creek is covered with oak, hickory, ash, elm, pecan, and dense underbrush.

T. 17 N., R. 15 E.—Ash, elm, hickory, cottonwood, black walnut, redbud, oak, sycamore, and pecan are found in large quantities on the river banks. The remaining portion of the township is generally rolling, covered with a thick growth of oak and hickory timber.

T. 18 N., R. 15 E.—Scattering timber, chiefly along creeks.

T. 19 N., R. 15 E.—About one-fourth wooded. Oak and hickory are the principal trees, but along the streams are found ash, elm, sycamore, and walnut.

T. 20 N., R. 15 E.—The river and creek bottoms are covered with a heavy growth of oak, hickory, ash, elm, hackberry, pecan, cottonwood, walnut, and sycamore timber.

T. 17 N., R. 16 E.—Large-sized trees, consisting of cottonwood, sycamore, oak, walnut, elm, ash, and box elder, are found in the river bottoms.

T. 18 N., R. 16 E.—This township is high, rolling prairie except in the eastern part along Verdigris River, which is low, level river-bottom land covered with a growth of oak, elm, ash, walnut, pecan, sycamore, cottonwood, and hickory timber, and a dense undergrowth of briers and vines.

T. 19 N., R. 16 E.—Nearly all timbered. The Verdigris River bottom is low and flat, and covered with a heavy growth of timber and underbrush. Timber consists of oak, ash, elm, walnut, pecan, hickory, sycamore, maple, willow, hackberry, cottonwood, dogwood, gum, cedar, and redbud.

T. 20 N., R. 16 E.—About one-half wooded. The Verdigris River bottom is covered with a heavy growth of oak, ash, elm, sycamore, mulberry, pecan, hackberry, and cottonwood. The uplands are covered with a growth of scrub oak and hickory.

TOWNSHIPS 17–20 NORTH, RANGES 17–20 EAST.

T. 17 N., R. 17 E.—Wooded principally in the bottom lands. Oak, hickory, pecan, maple, box elder, elm, sycamore, and cottonwood are the principal varieties of timber, and are of such a size as to be of considerable value.

T. 18 N., R. 17 E.—The bottom lands, a mile or more wide on either side of the Verdigris River, are thickly timbered with many kinds of trees.

T. 19 N., R. 17 E.—Timber is found in this township only along the banks of the creeks, and consists of elm, pecan, hickory, and sycamore.

T. 20 N. R. 17 E.—The timber in this township is located in the south-central portion and is of a very poor quality.

T. 17 N., R. 18 E.—In the southwestern corner of this township, and along the banks of Coal Creek, elm, ash, hickory, and the different species of oak timber are to be found.

T. 18 N., R. 18 E.—This township is gently rolling prairie, with some elm and ash timber along the banks of a few of the creeks.

T. 19 N., R. 18 E.—The wooded portion of this township is along the banks of Brush Creek, which are heavily timbered with elm and dense undergrowth.

T. 20 N., R. 18 E.—The only timber in this township is a narrow strip along Chouteau Creek, consisting of ash, oak, elm, pecan, sycamore, birch, and hickory.

T. 17 N., R. 19 E.—High, rolling prairie and wooded lands along the east and west, and low bottom lands along the center. Oak, elm, ash, hickory, hackberry, sycamore, walnut, and cottonwood timber grow in abundance in the bottoms.

T. 18 N., R. 19 E.—The timber is oak, ash, elm, hickory, pecan, hackberry, box elder, walnut, and coffee bean.

T. 19 N., R. 19 E.—This township, except in the southwest, which is partly prairie, is covered with a dense growth of oak, elm, and various other trees.

T. 20 N., R. 19 E.—There is some very good timber in the bottoms; the walnut, oak, and ash are valuable for lumber. The timber throughout the rest of the township is scattering, and fit only for fencing and fuel.

T. 17 N., R. 20 E.—The timber of the township consists of different species of oak, elm, ash, sycamore, pecan, walnut, hickory, and hackberry, with dense undergrowth.

T. 18 N., R. 20 E.—The timber consists largely of the different species of oak and hickory.

T. 19 N., R. 20 E.—The timber is oak and hickory, except on the creek and branches, where oak, elm, sycamore, willow, and hickory are found.

T. 20 N., R. 20 E.—About one-half wooded. The timber which grows on the flint hills and ridges is of poor grade; that in the bottoms is of fairly good quality. The oak, walnut, and cottonwood are suitable for lumber, the elm, ash, hickory, mulberry, and sycamore being suitable only for posts and fuel.

Townships 17–20 North, Ranges 21–24 East.

T. 17 N., R. 21 E.—The timber is oak and hickory, though other trees are found in small quantities.

T. 18 N., R. 21 E.—The timber is principally oak and hickory, with some pine.

T. 19 N., R. 21 E.—The township is mostly rolling and wooded. The timber consists principally of oak and hickory and scattering pine. There is a large sawmill in section 18 and a smaller one in section 10.

T. 20 N., R. 21 E.—This township contains rolling and level wooded and prairie lands. The timber consists of oak, elm, ash, pine, hackberry, sycamore, and hickory, useful for fencing or fuel.

T. 17 N., R. 22 E.—High, broken wooded land in the eastern and southern parts of this township. The bottom is timbered with oak, ash, hickory, walnut, and sycamore. The high, wooded land is timbered with oak, pine, and hickory, and considerable cutting has been done. There are several old sawmill sites in the township.

T. 18 N., R. 22 E.—The principal timber is oak, black-jack, hickory, elm, ash, sycamore, mulberry, and walnut.

T. 19 N., R. 22 E.—There is a fine growth of oak, hickory, elm, ash, sycamore, walnut, and locust timber throughout the entire township.

T. 20 N., R. 22 E.—The wooded portion of this township is rocky, and the timber is almost entirely oak and hickory.

T. 17 N., R. 23 E.—The principal timber is oak, elm, hickory, pine, ash, sycamore, hackberry, locust, and walnut.

T. 18 N., R. 23 E.—There is a sawmill in southeast corner of section 4. The timber is chiefly post oak, red oak, black-jack, hickory, elm, ash, walnut, sycamore, and pine, but the greater part of the latter has been cut.

T. 19 N., R. 23 E.—The timber consists of oak and hickory on the upland and oak, hickory, ash, elm, hackberry, and walnut on the bottom land.

T. 20 N., R. 23 E.—This township is composed of high wooded land, broken by deep ravines. The timber is mostly oak and walnut, with elm and sycamore in bottoms.

T. 17 N., R. 24 E.—This township is principally high, broken wooded land. The timber is mostly oak, hickory, and pine. The timber in the bottom along Barren Fork is oak, elm, sycamore, ash, walnut, and hackberry. There is a sawmill in section 7 and several old sawmill sites are located in different parts of the township.

T. 18 N., R. 24 E.—On the ridges in this township is found oak, and in the bottoms are walnut, oak, ash, hickory, and sycamore timber, with underbrush and vines.

T. 19 N., R. 24 E.—In the south and east portions the ridges are covered with various species of oak and pine, but the latter has been culled by the sawmills, one of which is located in section 23.

T. 20 N., R. 24 E.—Nearly all timbered.

Townships 17–20 North, Ranges 25–26 East.

T. 17 N., R. 25 E.—The timber in this township is mostly oak and hickory, with some scattering pine. Walnut, ash, elm, and sycamore are also found in the valleys.

T. 18 N., R. 25 E.—The timber is oak, black-jack, hickory, walnut, sycamore, and elm.

T. 19 N., R. 25 E.—Timber consists of oak, ash, elm, hickory, pine, sycamore, hackberry, walnut, and locust.

T. 20 N., R. 25 E.—A sawmill has lately been established in section 19, on Blue Spring Branch, to saw the pine found along the banks of Flint Creek.

T. 17 N., R. 26 E.—The timber is principally oak and hickory, with scattering pine in the southern part.

T. 18 N., R. 26 E.—The timber is composed of oak and hickory of no particular value.

T. 19 N., R. 26 E.—The timber in this township is oak, hickory, pine, and some cedar in the highlands; oak, hickory, sycamore, cottonwood, walnut, pecan, and wild plum in the bottoms. Undergrowth, hazelnut, vines, and briers.

T. 20 N., R. 26 E.—Partly wooded.

TOWNSHIPS 21–24 NORTH, RANGES 12–16 EAST.

T. 21 N., R. 12 E.—This fractional township is made up of rolling and mountainous wooded land, in the southern portion, and gently rolling prairie in the northern. Oak and hickory are the principal trees found on the uplands, while oak, ash, elm, walnut, pecan, sycamore, and hackberry grow in the creek bottoms.

T. 22 N., R. 12 E.—This fractional township is nearly all level. A belt of timber, extending along Bird Creek, about one-half mile in width, consists of species of oak, elm, hickory, ash, pecan, hackberry, cottonwood, and sycamore.

T. 23 N., R. 12 E.—This fractional township is partly wooded.

T. 24 N., R. 12 E.—This fractional township is about half prairie and half timbered land. The timber is oak, elm, hickory, and a little sycamore and cottonwood.

T. 21 N., R. 13 E.—Along Bird and Delaware creeks there is considerable flat land, covered, for the most part, with timber and underbrush. The timber consists of oak, hickory, elm, cottonwood, and walnut.

T. 22 N., R. 13 E.—Timber is scarce in this township, there being only a few trees scattered along the edges of small drains and creeks.

T. 23 N., R. 13 E.—Scattering trees are found only along creeks.

T. 24 N., R. 13 E.—No timber except along creeks.

T. 21 N., R. 14 E.—Oak, hickory, and elm are found in the southwestern part of the township.

T. 22 N., R. 14 E.—The bottom land of this township is well wooded, besides growing a dense underbrush. The timber consists of red oak, burr oak, elm, cottonwood, and sycamore.

T. 23 N., R. 14 E.—The township is all prairie except the bottom land. Here are found oak, elm, ash, walnut, pecan, hickory, sycamore, hackberry, and cottonwood.

T. 24 N., R. 14 E.—The timber along Caney Creek consists of oak, ash, elm, hickory, pecan, walnut, hackberry, maple, sycamore, and cottonwood.

T. 21 N., R. 15 E.—On the east side of the Verdigris River the bottom land is level and densely wooded with cottonwood, sycamore, oak, elm, ash, pecan, walnut, and hickory. On the west side of the river the land is broken and the timber is oak, elm, and hickory.

T. 22 N., R. 15 E.—Cottonwood, sycamore, elm, ash, and other kinds of timber are found along the Verdigris River and Caney Creek, oak and hickory in portions of the higher lands.

T. 23 N., R. 15 E.—Wooded in the southeast corner; the timber consists of oak, ash, elm, walnut, pecan, hickory, sycamore, cottonwood, and willow, with underbrush of same and briers and vines.

T. 24 N., R. 15 E.—Scattering elm, ash, and different species of oak and hackberry are found along the creeks.

T. 21 N., R. 16 E.—This township is divided into wooded and prairie land, the east and southern portions being timbered with oak, elm, and hickory.

T. 22 N., R. 16 E.—This township is of rolling prairie, except in the central part and along Dog Creek, which contains a growth of oak, elm, ash, walnut, pecan, hickory, sycamore, cottonwood, and hackberry.

T. 23 N., R. 16 E.—The Verdigris River bottom is covered with a heavy growth of pecan, elm, sycamore, ash, cottonwood, hackberry, walnut, and maple, together with a dense growth of underbrush.

T. 24 N., R. 16 E.—Ash, elm, cottonwood, and other timber are to be found along the Verdigris River and Talala Creek.

Townships 21–24 North, Ranges 17–20 East.

T. 21 N., R. 17 E.—There is very little timber in the township, and that is of inferior size and quality, being suitable only for fuel.

T. 22 N., R. 17 E.—This township is three-fourths wooded, but the timber is of inferior quality and fit only for fuel.

T. 23 N., R. 17 E.—The southern portions and some parts of the western and northern portions of this township are thickly covered with timber, mainly oak and hickory, and occasionally pecan and walnut.

T. 24 N., R. 17 E.—The surface of this township is rolling, broken, and wooded in the western portion. The timber is of inferior quality and of no commercial value.

T. 21 N., R. 18 E.—All but the eastern portion is high, rolling prairie, broken by numerous timbered ridges. In the northwest corner is a ridge timbered only by the different species of oak. In the creek bottoms all over the township elm, ash, and hickory are found.

T. 22 N., R. 18 E.—There is a strip of timber in the northern and central portions ranging in width from ½ mile to 2 miles. The various oaks and hickory are the only varieties found in the strip.

T. 23 N., R. 18 E.—The timber is oak, elm, hickory, ash, sycamore, and hackberry. The creeks have narrow, timbered bottoms.

T. 24 N., R. 18 E.—This township is composed of numerous timbered ridges in the northeast, central, and extreme southeast portions, covered with different species of oak.

T. 21 N., R. 19 E.—Timber is of poor quality and is found along the creeks.

T. 22 N., R. 19 E.—The only timber in this township is found along the creek and is chiefly oak, elm, walnut, and hickory, with dense underbrush and vines.

T. 23 N., R. 19 E.—With the exception of the extreme northwest and southeast corners, where there is scattering oak, elm, and hickory timber, this township is made up of gently rolling prairie.

T. 24 N., R. 19 E.—This township is divided between prairie and wooded land, about one-fourth being wooded. The western portion is high, rolling timbered land, the different species of oak predominating.

T. 21 N., R. 20 E.—About one-half wooded. Timber is oak and hickory; along the river bottoms are oak, ash, elm, hickory, pecan, hackberry, locust, and cottonwood.

T. 22 N., R. 20 E.—About one-fourth wooded. Heavy timber is found in the bottoms of this township. The more abundant kinds of trees are oak, elm, hickory, maple, walnut, ash, hackberry, and sycamore. The trees found on the ridges are chiefly oak, hickory, and black locust, and are small and of little commercial value.

T. 23 N., R. 20 E.—The timber in this township consists of oak, elm, ash, hickory, and walnut, principally along creeks.

T. 24 N., R. 20 E.—About one-half wooded. Along Big Cabin Creek the land is composed of low broken flint-stone ridges, covered with oak, hickory, elm, and pecan. Big Cabin Creek has a narrow, timbered bottom on either side.

Townships 21–24 North, Ranges 21–25 East.

T. 21 N., R. 21 E.—The timber comprises the various species of oak, and pine, elm, ash, and hickory of poor quality. There is a sawmill in section 15, cutting timber for local use.

T. 22 N., R. 21 E.—The timber on the ridges consists of various species of oak, and pine and hickory of good quality and size. The timber in the bottom consists of elm, ash, and walnut. Much walnut has been cut and shipped.

T. 23 N., R. 21 E.—All the land south of the river, except a very small portion known as Lynch Prairie, is rough, broken, and hilly, and covered with a dense growth of timber. The timber is of good quality, and is used for fuel and rough building purposes. The land on the north side of the river in the bottom is heavily timbered and covered with dense underbrush, green briers, and vines. There are three islands in Grand River heavily timbered.

T. 24 N., R. 21 E.—This township is about one-fourth covered with oak, hickory, elm, ash, and walnut timber in great abundance and of a fine quality.

T. 21 N., R. 22 E.—This township is very hilly and broken, with wooded ridges. Ash, elm, and sycamore grow in the bottom lands, and oak and hickory grow on the uplands. The white oak which grows here is of fine quality and of fair size.

T. 22 N., R. 22 E.—The township abounds in post oak, red oak, hickory, white oak, pine, sycamore, and elm timber of good quality.

T. 23 N., R. 22 E.—The timber of the township is composed of elm, ash, hickory, pecan, walnut, locust, hackberry, cottonwood, sycamore, and the different species of oak.

T. 24 N., R. 22 E.—Nearly all wooded. This township has high timbered ridges in the southeast and gently rolling timbered land in the southwestern portion. The timber of the township consists of elm, ash, pecan, hickory, hackberry, walnut, cedar, sycamore, cottonwood, various species of oak, and underbrush.

T. 21 N., R. 23 E.—Timber on ridges consists of oak and hickory, with some scattering pine; in bottoms of oak, elm, ash, pecan, walnut, sycamore, and hickory.

T. 22 N., R. 23 E.—The timber on the ridges consists chiefly of the various species of oak, hickory, pine, and cedar, of good quality. In the bottoms excellent walnut, elm, ash, oak, sycamore, and hackberry are found.

T. 23 N., R. 23 E.—The timber is composed principally of various species of oaks, hickory, and elm, with some walnut and ash along the creek bottoms.

T. 24 N., R. 23 E.—Timber along river is oak, elm, hackberry, walnut, hickory, ash, and maple.

T. 21 N., R. 24 E.—The timber is composed largely of hickory, pine, and the different species of oak, sycamore, elm, ash, cottonwood, and pecan, found in Spavinaw River bottom and along the banks of Cloud Creek. There is a sawmill in section 8, on the bank of Cloud Creek.

T. 22 N., R. 24 E.—The timber in this township consists of the different species of oak, hickory, and pine along the ridges, and of oak, ash, elm, sycamore, and hickory in the bottoms.

T. 23 N., R. 24 E.—The timber of the township is nearly all composed of various species of oak and hickory. Some elm and sycamore are found in the creek bottoms.

T. 24 N., R 24 E.—The south half of this township is wooded.

T. 21 N., R. 25 E.—The ridges and canyons of this township are covered with a dense growth of various species of oak and hickory timber, and in the bottoms along the creeks are found elm, ash, sycamore, and walnut.

T. 22 N., R. 25 E.—More than one-half of the township is wooded land, covered with post oak, black oak, black-jack, hickory, and some elm, ash, and walnut in the canyons and along the creeks. The timber in the bottoms is very dense and some of it is large. There is a sawmill located in section 32, running steadily, with a capacity of about 5,000 feet of lumber a day and furnishing employment for 15 or 20 men.

T. 23 N., R. 25 E.—This township is composed of level, gently rolling, and broken land, which is nearly all covered with oak and hickory timber. The timber is fit only for fencing and fuel.

T. 24 N., R. 25 E.—The southern part of this township is rolling and broken, and is covered with a heavy growth of oak, elm, and hickory timber. The timber in the southern part is oak and hickory of an inferior character. Oak, elm, sycamore, ash, hickory, and persimmon are found along the creeks, and are of fairly good quality.

TOWNSHIPS 25–29 NORTH, RANGES 12–16 EAST.

T. 25 N., R. 12 E.—Caney Creek runs across the northeastern corner of the township, and has a narrow, fertile bottom, which is timbered with oak, elm, cottonwood, and sycamore. The remainder of the township, which is fractional, is broken, generally wooded land, the timber consisting of oak, elm, and hickory.

T. 26 N., R. 12 E.—The southern part of this fractional township is mountainous and timbered with small oak and hickory. Timber in northern part consists of oak, ash, elm, pecan, hickory, cottonwood, and sycamore.

T. 27 N., R. 12 E.—A high range runs through the western part of this fractional township, which is timbered with oak, elm, and hickory. Caney Creek flows through the eastern part. Its bottom land is fertile and timbered with oak, elm, cottonwood, pecan, sycamore, walnut, and hickory.

T. 28 N., R. 12 E.—Oak, hickory, elm, and cottonwood timber is found along Caney Creek, in the southwest part.

T. 29 N., R. 12 E.—No timber in this township.

T. 25 N., R. 13 E.—The timber consists of oak, ash, elm, hickory, walnut, pecan, sycamore, and cottonwood along the creek bottoms.

T. 26 N., R. 13 E.—The timber along Caney Creek and its tributaries consists of oak, ash, elm, hickory, pecan, walnut, box elder, maple, and sycamore.

T. 27 N., R. 13 E.—The timber along Caney Creek and its tributaries—Little Caney, Coon, and Fourmile creeks—consists of oak, elm, hickory, walnut, pecan, cottonwood, and sycamore.

T. 28 N., R. 13 E.—Oak, ash, elm, walnut, and other kinds of timber are found along the creeks.

T. 29 N., R. 13 E.—The only timber in this township is along the water courses, consisting of oak, elm, walnut, sycamore, and hickory.

T. 25 N., R. 14 E.—Wooded only along water courses.

T. 26 N., R. 14 E.—Hogshooter Creek flows through the western part of this township, and along its banks grow oak, elm, ash, pecan, hickory, walnut, and sycamore timber.

T. 27 N., R. 14 E.—On the ridges the timber is scattering and nearly all small, consisting of oak, hickory, elm, pecan, and persimmon.

T. 28 N., R. 14 E.—In sections 7, 8, 9, 10, and 19 there are ridges and mounds covered with scattering scrub oak timber, and some timber is found along the creeks and branches.

T. 29 N., R. 14 E.—Partly wooded in the eastern portion.

T. 25 N., R. 15 E.—Very little timber found in this township.

T. 26 N., R. 15 E.—Elm, oak, and hickory timber is found on the banks of creeks.

T. 27 N., R. 15 E.—Scattering oak, elm, ash, hickory, and pecan timber is found along the creek bottoms.

T. 28 N., R. 15 E.—The northwestern portion of this township is very well timbered with hickory and the various species of oak; also scattering elm and hackberry is found in the creek bottoms.

T. 29 N., R. 15 E.—The timber in the eastern portion of this township is elm, scrub oak, and sycamore, found along creeks and branches. In the western portion are oak, hickory, walnut, and dense undergrowth.

T. 25 N., R. 16 E.—The bottom lands of this township are heavily timbered with oak, elm, hickory, cottonwood, sycamore, and walnut.

T. 26 N., R. 16 E.—Oak, ash, elm, and scattering walnut are found along the Verdigris River.

T. 27 N., R. 16 E.—The Verdigris River bottom is covered with a heavy growth of elm, pecan, ash, sycamore, hackberry, walnut, and cottonwood, together with a dense growth of underbrush.

T. 28 N., R. 16 E.—The large river bottoms are covered with a heavy growth of oak, hickory, elm, walnut, pecan, box elder, maple, and sycamore timber.

T. 29 N., R. 16 E.—The timber is oak, elm, hickory, ash, pecan, hackberry, cottonwood, and sycamore.

TOWNSHIPS 25–29 NORTH, RANGES 17–20 EAST.

T. 25 N., R. 17 E.—The timber consists of species of oak, ash, walnut, hickory, elm, cottonwood, sycamore, and pecan, mostly along the streams.

T. 26 N., R. 17 E.—The township is divided into one-fourth wooded and three-fourths prairie land.

T. 27 N., R. 17 E.—Big and Coal creeks have narrow bottoms and dense timber of oak, elm, hickory, ash, walnut, pecan, hackberry, sycamore, and cottonwood.

T. 28 N., R. 17 E.—Oak, elm, sycamore, hickory, and cedar timber, with thick underbrush, is found along the creeks and branches.

T. 29 N., R. 17 E.—Timber, consisting of elm, oak, and ash, is scarce and found only on the borders of streams, in the southeastern and extreme western portions of the township.

T. 25 N., R. 18 E.—Largely rolling prairie land, with a few wooded hills. In the southern portions and in the creek bottoms, oak, elm, and hickory are found.

T. 26 N., R. 18 E.—A belt of oak, hickory, elm, and sycamore timber is found on Lightning Creek.

T. 27 N., R. 18 E.—Elm, oak, walnut, and sycamore timber is found along the creeks and branches in this township.

T. 28 N., R. 18 E.—The banks of some of the streams are skirted with timber consisting of oak, elm, ash, hickory, walnut, and hackberry.

T. 29 N., R. 18 E.—Timber is not very abundant and is found only on the borders of the streams, particularly in the southern half of the township. It consists of oak, elm, hickory, sycamore, ash, hackberry, and cottonwood.

T. 25 N., R. 19 E.—This township is nearly all rolling prairie, except timbered ridges in the southwestern and broken land in the north-central parts and a narrow timbered bottom along Pawpaw and Pecan creeks.

T. 26 N., R. 19 E.—Scattering timber of oak, elm, walnut, and hickory along the creeks.

T. 27 N., R. 19 E.—No timber in this township.

T. 28 N., R. 19 E.—In the northwestern and northeastern parts some oak, elm, hickory, and hackberry timber is found.

T. 29 N., R. 19 E.—Along Cabin Creek, in the southeastern part of the township, is to be found some timber, consisting of species of oak, hickory, and elm.

T. 25 N., R. 20 E.—Along the streams are found many kinds of timber, the most prominent varieties being oak, hickory, ash, elm, pecan, sycamore, hackberry, and cottonwood. The hills of sections 5 and 6 are covered with black-jack and post oak.

T. 26 N., R. 20 E.—Ash, oak, elm, walnut, and other kinds of timber are found along Big Cabin Creek.

T. 27 N., R. 20 E.—There is timber in the southeastern corner and a strip of timber along Big Cabin Creek, consisting of oak, ash, elm, hickory, pecan, hackberry, sycamore, and maple.

T. 28 N., R. 20 E.—The only timbered land in this township is in the western and northwestern portions and along Big Cabin Creek. The timber is oak, hickory, ash, elm, cottonwood, sycamore, walnut, and pecan. Most of it is small and of little value commercially.

T. 29 N., R. 20 E.—This township is rolling prairie, except narrow strips of timber along either side of Russell Creek, consisting of oak, elm, ash, and sycamore of little value commercially.

TOWNSHIPS 25–29 NORTH, RANGES 21–25 EAST.

T. 25 N., R. 21 E.—This township is rolling prairie land, except a narrow strip of timbered bottom land along Little Cabin Creek. The timber is composed of oak, ash, elm, walnut, and sycamore.

T. 26 N., R. 21 E.—Timber along banks of creeks is oak, hickory, ash, elm, hackberry, and sycamore.

T. 27 N., R. 21 E.—In places along Little Cabin Creek there is timber, such as oak, ash, elm, and hackberry.

T. 28 N., R. 21 E.—The northeastern part of this township is very stony and broken, and is covered with a dense growth of scrub oak. Scattering oak, elm, and ash timber is found along Cow Creek.

T. 29 N., R. 21 E.—The timber along the creeks is oak, hickory, elm, sycamore, hackberry, and cottonwood.

T. 25 N., R. 22 E.—Along the banks of a few creeks is found a scattering growth of oak, elm, pecan, and walnut timber.

T. 26 N., R. 22 E.—This township is without timber.

T. 27 N., R. 22 E.—This township is timberless.

T. 28 N., R. 22 E.—Timber is found along the Neosho River.

T. 29 N., R. 22 E.—Without timber.

T. 25 N., R. 23 E.—The surface is divided into high, rocky, wooded, rolling prairie, and river bottom land. The timbered land is in the northeast and the southern parts of the township, the principal timber being black-jack. The timber in general throughout the township consists of oak, ash, cottonwood, sycamore, elm, hickory, walnut, hackberry, dogwood, and some scattering pine along the bluff on south side of river.

T. 26 N., R. 23 E.—The extreme eastern part of this township is very rocky and broken, and is covered with a scrubby growth of hickory and oak timber.

T. 27 N., R. 23 E.—This township is divided into gently rolling prairie land in the south and west, and rolling and level timbered land in the eastern part. Along Grand River, where the land is not in cultivation, it is heavily timbered with oak, elm, hickory, sycamore, ash, maple, and willow. The ridges have post oak, red oak, black-jack, and hickory.

T. 28 N., R. 23 E.—This fractional township is covered with a dense growth of heavy timber, briers, and underbrush. The timber consists of oak, elm, ash, pecan, maple, sycamore, and cottonwood.

T. 25 N., R. 24 E.—The part cut off by Grand River is timbered with oak and hickory. The southern portion is principally prairie, but some oak, hickory, and hackberry timber is found along Wolf Creek.

T. 26 N., R. 24 E.—The timber is oak, locust, elm, ash, hickory, and pecan.

T. 27 N., R. 24 E.—Timber consists of oak, elm, hickory, sycamore, and cottonwood.

T. 25 N., R. 25 E.—The timber is scattering oak, hickory, elm, and walnut.

TOWNSHIPS 1–5 SOUTH, RANGES 1–4 WEST.

T. 1 S., R. 1 W.—This township is located in a range of hills, partly timbered, known as Arbuckle Mountains. The northeastern part of the township is heavily timbered.

T. 2 S., R. 1 W.—Along the banks of Spring and Hickory creeks is found considerable oak, elm, and pecan timber.

T. 3 S., R. 1 W.—This township is about equally divided between cultivated and rolling timbered land.

T. 4 S., R. 1 W.—This township is mostly timbered land.

T. 5 S., R. 1 W.—This township is rolling land, covered with oak, elm, and hickory timber, a considerable portion of which is found along Demijohn and Bull creeks.

T. 1 S., R. 2 W.—Oak, elm, pecan, ash, and cottonwood are found along the creeks and in the western portion.

T. 2 S., R. 2 W.—Oak, elm, and hickory timber is found over two-thirds of the area.

T. 3 S., R. 2 W.—This township is rolling and nearly all timbered land. The principal trees are oak, elm, ash, hickory, and walnut, with some hackberry and cottonwood on the creeks.

T. 4 S., R. 2 W.—This township contains rolling wooded land, the timber consisting of oak, black-jack, and hickory, and along the streams cottonwood, hackberry, sycamore, pecan, and elm.

T. 5 S., R. 2 W.—This township contains rolling wooded land, the timber consisting of oak, elm, black-jack, and hickory.

T. 1 S., R. 3 W.—This township is rolling wooded land. There is considerable oak, elm, cottonwood, dogwood, walnut, and ash timber along Wild Horse Creek and other streams.

T. 2 S., R 3 W.—This township is slightly rolling and for the greater part is timbered with post oak and black-jack, with occasional elm and cottonwood along the streams.

T. 3 S., R. 3 W.—This township is nearly all timbered. The timber in the bottoms is oak, elm, and cottonwood. The remainder of the township is rolling land, timbered with oak and hickory.

T. 4 S., R. 3 W.—About one-half wooded. The timber is principally oak, with some elm along the streams.

T. 5 S., R. 3 W.—About one-half wooded. The timber is principally oak, with some elm and hackberry along the streams.

T. 1 S., R. 4 W.—This township is rolling wooded land, covered with thick undergrowth. The timber consists of oak, elm, and ash, with some cottonwood and walnut along the creeks and branches.

T. 2 S., R. 4 W.—This area is nearly all rolling wooded land.

T. 3 S., R. 4 W.—This township is rolling wooded land, with the exception of some prairie in the southern and northwestern parts.

T. 4 S., R. 4 W.—The only timber of consequence is found along the creeks and branches, and consists of oak, elm, walnut, pecan, hickory, hackberry, and cottonwood.

T. 5 S., R. 4 W.—This township is rolling land. The principal trees, which are found along streams, are oak, elm, ash, hickory, walnut, pecan, hackberry, and cottonwood.

Townships 1–5 South, Ranges 5–8 West.

T. 1 S., R. 5 W.—About two-thirds wooded. The timber of the uplands is oak, while that of the bottoms is elm, pecan, and walnut.

T. 2 S., R. 5 W.—The northern half is wooded. Oak, elm, pecan, walnut, and cottonwood timber is found along the creeks.

T. 3 S., R. 5 W.—Elm, oak, cottonwood, walnut, and pecan timber is found along Pike, Mountain, and Negro creeks and Willow Branch and their numerous tributaries.

T. 4 S., R. 5 W.—This area contains rolling prairie land. Timber is found along Mud and Negro creeks.

T. 5 S., R. 5 W.—This township contains rolling prairie. The only timber, consisting of oak, elm, ash, and pecan, is found in the southeastern part of the township.

T. 1 S., R. 6 W.—The southern portion of this township is rough, and is timbered with oak, cottonwood, elm, and pecan along streams.

T. 2 S., R. 6 W.—Oak, elm, and pecan timber is found in the eastern and northern parts of the township.

T. 3 S., R. 6 W.—The only timber found is along the streams.

T. 4 S., R. 6 W.—There is but little timber. Elm, cottonwood, pecan, ash, hackberry, and chinaberry are found on West Mud Creek and Crooked Creek.

T. 5 S., R. 6 W.—Oak, elm, and pecan are found along West Mud Creek. There is no other timber excepting along the streams.

T. 1 S., R. 7 W.—The southern part of the township is timbered with oak and with scattering elm, hackberry, cottonwood, and pecan. There are patches of oak timber along the base line on the north.

T. 2 S., R. 7 W.—This township is prairie in the southeast and timbered land in the other portions. The principal timber is oak. The branches and creeks are skirted with elm, cottonwood, pecan, and hackberry.

T. 3 S., R. 7 W.—The only timber is found in the northwest corner.

T. 4 S., R. 7 W.—All the creeks are skirted with a growth of cottonwood, elm, pecan, hackberry, and ash timber, which is the only timber found in the township.

T. 5 S., R. 7 W.—The only timber is found in the western potrion and consists of oak, elm, hackberry, hickory, and walnut.

T. 1 S., R. 8 W.—There is some timber in this small fractional township.

T. 2 S., R. 8 W.—Nearly one-half of this fractional township is under cultivation; the remainder is covered with a growth of oak timber.

T. 3 S., R. 8 W.—This fractional township is almost entirely timbered land.

T. 4 S., R. 8 W.—Cow Creek is skirted with cottonwood, elm, hackberry, and oak, with dense growth of underbrush and vines.

T. 5 S., R. 8 W.—The timber is principally oak, with some scattering elm and pecan.

TOWNSHIPS 6–8 SOUTH, RANGES 1–4 WEST.

T. 6 S., R. 1 W.—Timber, consisting of oak, hickory, elm, hackberry, and pecan, covers about one-half the township.

T. 7 S., R. 1 W.—About one-half the land is timbered with oak, walnut, ash, elm, pecan, and hickory. The timber is of little value commercially.

T. 8 S., R. 1 W.—A part of the township is under cultivation. The remainder is covered with a heavy growth of oak, elm, ash, hickory, pecan, hackberry, and cottonwood, with scattered cedar along the river.

T. 6 S., R. 2 W.—This township is nearly all rolling wooded land, covered with oak on the upland, and elm, hickory, walnut, and pecan along the creek bottoms.

T. 7 S., R. 2 W.—This township is principally rolling wooded land, covered with oak and hickory timber.

T. 8 S., R. 2 W.—This township contains a gently rolling surface which is covered with ash and hickory timber. A strip along Red River is covered with oak, elm, pecan, hickory, willow, hackberry, and cottonwood.

T. 6 S., R. 3 W.—The eastern and southern portions of this township are rolling and rough and contain considerable timber. Oak, elm, hickory, pecan, ash, and hackberry timber is found along Mud Creek and Clear Creek and the numerous branches.

T. 7 S., R. 3 W.—This township is nearly all timbered land, consisting of oak, elm, and hickory on the uplands, and walnut, pecan, ash, cottonwood, and hackberry along the streams.

T. 8 S., R. 3 W.—The land of this small fractional township is level bottom and is covered with oak, elm, pecan, hickory, hackberry, and cottonwood timber.

T. 6 S., R. 4 W.—Timber consists of oak, hickory, cottonwood, and box elder.

T. 7 S., R. 4 W.—The principal timber of the upland is oak, with an addition of elm, cottonwood, pecan, ash, hackberry, and willow along the river.

Townships 6–8 South, Ranges 5–8 West.

T. 6 S., R. 5 W.—This township is rolling prairie, with some timber in the northeast and southeast corners.

T. 7 S., R. 5 W.—Timbered along Red River.

T. 6 S., R. 6 W.—There is no timber except on Red River and its branches.

T. 7 S., R. 6 W.—There is some oak, elm, and cottonwood timber bordering the river.

T. 8 S., R. 6 W.—Considerable cottonwood timber is found along Red River and Fleetwood Creek.

T. 6 S., R. 7 W.—There is some elm and cottonwood timber on Red River.

T. 7 S., R. 7 W.—This township is principally prairie, with some brushy black-jack timber in the southeastern part. Elm and cottonwood timber is found along Red River.

T. 8 S., R. 7 W.—The timber along Red River consists of elm, pecan, cottonwood, and walnut.

T. 6 S., R. 8 W.—There is some black-jack timber in the northeastern portion of section 1, and also on the river in sections 25 and 26.

Townships 1–4 North, Ranges 1–4 West.

T. 1 N., R. 1 W.—A large portion of the land north of Wild Horse Creek is covered with post-oak runners. The remaining portion of the creek bottom is covered with briers, dense underbrush, and heavy timber.

T. 2 N., R. 1 W.—The extreme eastern and western portions of this township are timbered, the principal varieties being oak, hickory, elm, dogwood, and pecan.

T. 3 N., R. 1 W.—The timber consists of the different species of oak, elm, ash, hackberry, and pecan, of no commercial value.

T. 4 N., R. 1 W.—There is considerable timber along the banks of the Washita River, Cheek Creek, and the numerous streams, consisting of oak, elm, black-jack, pecan, walnut, and hackberry.

T. 1 N., R. 2 W.—This township consists generally of rolling and level land, covered with oak, elm, pecan, and hickory timber.

T. 2 N., R. 2 W.—The only timber found is on the creeks and consists of oak, elm, cottonwood, and pecan.

T. 3 N., R. 2 W.—The timber consists of the various species of oak, elm, hackberry, and pecan.

T. 4 N., R. 2 W.—The Washita Valley, where not in cultivation, is covered by a growth of oak, ash, elm, pecan, cottonwood, and hackberry timber.

T. 1 N., R. 3 W.—This township is rolling wooded land, almost entirely covered with a thick growth of post-oak runners. The timber of the township consists of hickory, elm, ash, hackberry, and the different species of oak.

T. 2 N., R. 3 W.—This township consists of rolling timbered land and prairie in the south and table hills in the north. Oak, hickory, pecan, elm, and walnut are the principal trees.

T. 3 N., R. 3 W.—The timber of the township consists of oak, elm, hickory, hackberry, and pecan.

T. 4 N., R. 3 W.—The timber of the township consists of oak, elm, ash, sycamore, dogwood, cottonwood, and hickory, with thick growth of briers along the river.

T. 1 N., R. 4 W.—The southeastern half of this township is rolling timbered land, while the balance is prairie. The timber consists of elm, ash, walnut, hickory, cottonwood and the different species of oak.

T. 2 N., R. 4 W.—Nearly all wooded. The principal timber consists of the different species of oak, with some pecan, elm, and walnut on the streams.

T. 3 N., R. 4 W.—The township is nearly all rolling wooded land. The timber is oak, cottonwood, elm, ash, hickory, pecan, mulberry, and hackberry in the bottoms, and on the rolling land it consists of oak, hickory, and elm.

T. 4 N., R. 4 W.—Timber on river and creeks is oak, elm, and cottonwood.

Townships 1–4 North, Ranges 5–8 West.

T. 1 N., R. 5 W.—The central and northern portions are gently rolling prairie and open timbered lands. The timber consists almost entirely of oak. There is some scattering elm and cottonwood found along the streams.

T. 2 N., R. 5 W.—This township contains bottom land and high rolling wooded land. The timbered land is sandy and has a thick growth of oak.

T. 3 N., R. 5 W.—Oak, elm, hickory, and pecan timber is found throughout the township.

T. 4 N., R. 5 W.—This township is high, rolling timbered land.

T. 1 N., R. 6 W.—Two-thirds wooded. Oak, hickory, elm, and cottonwood are found along streams.

T. 2 N., R. 6 W.—Considerable timber is found in the southern portion of the township, consisting of oak, elm, cottonwood, and box elder.

T. 3 N., R. 6 W.—A small area is wooded. Oak is the principal timber, but on the creeks, elm and hackberry are also found.

T. 4 N., R. 6 W.—This township has some scattering post oak along the eastern part, and some oak, elm, and cottonwood on the streams, but it is practically all prairie.

T. 1 N., R. 7 W.—Nearly all wooded. There is considerable scrubby oak timber found along the Cow and Wild Horse creeks and their branches; also elm, ash, and hickory.

T. 2 N., R. 7 W.—In the south and northwest portions of this township, which is nearly all prairie, elm, cottonwood, and oak timber is found.

T. 3 N., R. 7 W.—The southeast corner of this township is covered with scattering black oak timber. Along Rush Creek and the principal streams occur elm, oak, and cottonwood.

T. 4 N., R. 7 W.—Two-thirds wooded. Considerable oak, elm, and cottonwood timber is found along the streams. The northern portion of this township is very rough and contains considerable timber.

T. 1 N., R. 8 W.—Considerable oak timber is found along the streams in this small fractional township.

T. 2 N., R. 8 W.—Oak timber is to be found along the streams of this fractional township.

TOWNSHIPS 5–8 NORTH, RANGES 1–4 WEST.

T. 5 N., R. 1 W.—The only timber found is along the creeks and drains, and consists of oak, elm, pecan, hackberry, and walnut.

T. 6 N., R. 1 W.—The timber in this fractional township is oak, elm, walnut, sycamore, and cottonwood along the Canadian River.

T. 5 N., R. 2 W.—Timber consists of cottonwood, elm, and black-jack, and scattering pecan in the bottoms along Finn Creek and other streams.

T. 6 N., R. 2 W.—This township is high rolling prairie, cut by deep, timbered ravines. The timber consists principally of oak, elm, and cottonwood.

T. 7 N., R. 2 W.—Cottonwood and elm are found along Walnut Creek and the numerous other streams.

T. 8 N., R. 2 W.—This fractional township contains rolling and level prairie and wooded lands. The timber is cottonwood, oak, elm, walnut, pecan, and willow.

T. 5 N., R. 3 W.—There is considerable timber along the banks of Criner Creek, consisting of elm, cottonwood, dogwood, ash, walnut, oak, and pecan.

T. 6 N., R. 3 W.—The northwest portion of the township is covered with scrubby post-oak and black-jack timber of very little value.

T. 7 N., R. 3 W.—This township is a rolling prairie, broken by deep timbered ravines. The timber is oak, walnut, pecan, elm, cottonwood, and hackberry.

T. 8 N., R. 3 W.—With the exception of a strip along Canadian River, this township is rolling prairie. There is a scattering growth of timber along the river, consisting of elm, ash, cottonwood, and willow.

T. 5 N., R. 4 W.—There are a few patches of scrub-oak timber in the northwest portion of the township. The principal timber found along the creeks and drains consists of oak, elm, ash, and cottonwood.

T. 6 N., R. 4 W.—This township is about three-fourths timber. The uplands are of light, sandy soil, covered with post oak.

T. 7 N., R. 4 W.—The entire township is high, rolling land, nearly all covered with a growth of scrub post-oak and black-jack timber.

T. 8 N., R. 4 W.—The western portion of the township is timbered with scrubby and scattering black-jack. There is considerable timber along Walnut Creek, and its numerous branches, consisting of elm, cottonwood, ash, and walnut.

TOWNSHIPS 5–8 NORTH, RANGES 5–7 WEST.

T. 5 N., R. 5 W.—The Washita River bottom is level, about one-half under cultivation. The remaining portion is covered with elm, walnut, cottonwood, dogwood, and oak timber. The southwestern and northwestern portions are rolling prairies, with a few groves of post-oak and black-jack timber. Elm and cottonwood are found on the streams.

T. 6 N., R. 5 W.—This township is rolling and nearly all timbered land. The soil is sandy and covered with post-oak and black-jack timber.

T. 7 N., R. 5 W.—About one-half of this township is covered with post-oak and black-jack timber. The timber is located principally in the east and southeast parts of the township. Post oak, black-jack, elm, and cottonwood are found along Walnut and on East and West Winter creeks.

T. 8 N., R. 5 W.—Timber of scattered oak, in sections 25, 26, 35, and 36, occurs in small groves only. Some cottonwood and elm grow near creeks.

T. 5 N., R. 6 W.—There are several small streams in this township, along the banks of which considerable timber is found, consisting of elm, oak, cottonwood, and box elder.

T. 6 N., R. 6 W.—This township is, for the most part, prairie, excepting heavy timber, brush, and undergrowth which grows on each side of the Washita River, with a width of about a quarter of a mile.

T. 7 N., R. 6 W.—There is some scattering timber found along the streams and branches, consisting of elm, pecan, cottonwood, redbud, mulberry, and hackberry.

T. 8 N., R. 6 W.—Timber is found along the banks of creeks, consisting of cottonwood, elm, walnut, and redbud, but only scattering.

T. 5 N., R. 7 W.—There is some scrub oak timber in the extreme southern part and along the streams.

T. 6 N., R. 7 W.—The only timber found is along Washita and Little Washita rivers and the numerous streams, and consists principally of elm, cottonwood, and walnut.

T. 7 N., R. 7 W.—The only timber found is along the river and creeks, and consists of cottonwood, elm, and hackberry.

T. 8 N., R. 7 W.—Without timber.

TOWNSHIPS 9–10 NORTH, RANGES 3–7 WEST.

T. 9 N., R. 3 W.—The timber is cottonwood and elm along the river.

T. 9 N., R. 4 W.—There is a strip of low bottom land, about one-fourth to three-fourths of a mile wide, along the Canadian River. This bottom is sandy and timbered with cottonwood. The western portion of the township is rolling and timbered with scrubby black-jack.

T. 10 N., R. 4 W.—This township contains rolling prairie and timbered land.

T. 9 N., R. 5 W.—The eastern portion of this township is covered with post-oak and black-jack timber. The western part is rolling prairie.

T. 10 N., R. 5 W.—The timber along the branches of the Canadian River consists of oak and elm, while that along the river is chiefly willow and cottonwood.

T. 9 N., R. 6 W.—There is no timber in this township.

T. 10 N., R. 6 W.—The land is high, rolling prairie, with scattering timber, consisting of cottonwood, elm, walnut, and willow, along streams.

T. 9 N., R. 7 W.—The only timber in the township is found scattered along the streams, and consists of oak, elm, and cottonwood.

T. 10 N., R. 7 W.—This township is not timbered.

TOWNSHIPS 1–6 NORTH, RANGES 1–4 EAST.

T. 1 N., R. 1 E.—About one-quarter of the township is prairie, the remaining portion being covered with oak and hickory timber. Along the river bottom is found a heavy growth of walnut, sycamore, cottonwood, pecan, elm, ash, and hickory of little value commercially.

T. 2 N., R. 1 E.—About one-half of this valley is under cultivation; the remaining portion is timbered with various species of oak, hickory, and elm.

T. 3 N., R. 1 E.—The timber, which grows principally along streams, is of little value commercially; it consists of oak, elm, sycamore, walnut, and pecan.

T. 4 N., R. 1 E.—About three-fourths of the township is prairie, while the remainder is covered with oak, elm, and black-jack timber, except along the streams, where an abundant growth of walnut, ash, pecan, sycamore, and cottonwood is found.

T. 5 N., R. 1 E.—The extreme northern and southern portions of this township are covered with timber, consisting of oak, ash, hickory, cottonwood, walnut, and pecan. The land along the Canadian River is very fertile and is covered with sycamore, walnut, ash, pecan, and willow timber, with dense underbrush.

T. 6 N., R. 1 E.—Timber consists of cottonwood, oak, elm, pecan, and willow.

T. 1 N., R. 2 E.—About one-fourth of the township is timbered, and the remainder is prairie.

T. 2 N., R. 2 E.—About one-half is timbered, and the remainder is prairie. The timber consists of oak, hickory, elm, and pecan.

T. 3 N., R. 2 E.—The north and west portions are high, rolling prairie; the remainder is timbered with oak, elm, hickory, pecan, ash, and hackberry.

T. 4 N., R. 2 E.—Only that portion bordering on the creeks and branches is timbered; the balance is prairie. Oak, pecan, elm, ash, hickory, and walnut are found in the bottoms.

T. 5 N., R. 2 E.—The timber, which is found on streams, is oak, elm, pecan, sycamore, and cottonwood.

T. 1 N., R. 3 E.—The timber, consisting of narrow belts along the creeks and branches, is oak, ash, elm, hickory, and pecan.

T. 2 N., R. 3 E.—This township contains principally rolling timbered land. It is covered with various species of oak, elm, and hickory.

T. 3 N., R. 3 E.—This township is of gently rolling surface, nearly all timbered with oak and elm.

T. 4 N., R. 3 E.—The portions bordering the creeks and branches are timbered with oak, ash, elm, pecan, and hickory of no commercial value.

T. 5 N., R. 3 E.—About one-fourth of the township is prairie and the remainder is timbered. Oak, pecan, walnut, elm, and hickory of fair quality are found in the bottoms.

T. 6 N., R. 3 E.—This fractional township is nearly all wooded.

T. 1 N., R. 4 E.—In places scattering oak, elm, pecan, and cottonwood are found along the creeks and branches.

T. 2 N., R. 4 E.—About nine sections in the northwestern portion of the township have a dense growth of dwarfed black-jack, post oak, red oak, and hickory. There is no timber in the township of any commercial value.

T. 3 N., R. 4 E.—This township is mostly rolling wooded land. The timber consists of oak, elm, ash, walnut, pecan, hickory, bois d'arc, hackberry, and undergrowth.

T. 4 N., R. 4 E.—This township is nearly all rolling prairie, except the extreme eastern, northern, and northwestern portions, which are covered with oak, hickory, and black-jack timber.

T. 5 N., R. 4 E.—The land in this township is rolling and level, nearly all covered with oak and hickory timber, fit only for fuel.

T. 6 N., R. 4 E.—The timber is oak, elm, willow, and cottonwood.

Townships 1–5 North, Ranges 5–8 East.

T. 1 N., R. 5 E.—The timber, which consists of oak, elm, hickory, and pecan, is found along Little Blue Creek and other streams and in sections 9, 10, 15, and 16.

T. 2 N., R. 5 E.—The timber, which consists of oak, elm, hickory, ash, pecan, and walnut, is scarce and is found only along the creeks and branches.

T. 3 N., R. 5 E.—The southern part is about one-half prairie and one-half timbered. The northern part is nearly all timbered with oak and hickory, and elm, walnut, and ash, along the streams.

T. 4 N., R. 5 E.—This township contains principally rolling, timbered land. The timber is principally oak and hickory and is found on the uplands alone. Elm, ash, oak, hickory, hackberry, and pecan are found along the creeks.

T. 5 N., R. 5 E. (*Chickasaw Nation*).—Nearly all wooded; the timber is oak, ash, elm, pecan, hickory, and cottonwood.

T. 1 N., R. 6 E.—Nearly the entire township is prairie, but oak, elm, ash, hickory, pecan, and sycamore are found on the water courses.

T. 2 N., R. 6 E.—About one-half wooded; the timber consists of oak, elm, ash, pecan, walnut, hickory, sycamore, hackberry, and cottonwood.

T. 3 N., R. 6 E.—About one-half wooded; the timber consists of oak, elm, ash, pecan, walnut, hickory, sycamore, and hackberry.

T. 4 N., R. 6 E.—Two-thirds wooded; the timber consists of oak, elm, ash, pecan, walnut, hickory, sycamore, and hackberry.

T. 5 N., R. 6 E. (*Chickasaw Nation*).—This township consists mostly of rolling surface, nearly all of which is heavily timbered with oak, ash, elm, cedar, sycamore, pecan, and cottonwood.

T. 1 N., R. 7 E.—About one-half wooded; the timber consists of oak, hickory, and elm.

T. 2 N., R. 7 E.—Two-thirds wooded. Oak, elm, ash, pecan, and other kinds of timber are found throughout the township.

T. 3 N., R. 7 E.—Two-thirds wooded. Oak, elm, and hickory are the principal kinds of timber. Small quantities of ash and walnut are found, which are of no commercial value.

T. 4 N., R. 7 E.—Nearly all wooded. Oak, elm, hickory, and ash are the principal kinds of timber found throughout the township. Walnut and pecan are found, but are scattering.

T. 5 N., R. 7 E. (*Chickasaw Nation*).—This township contains nearly all rolling wooded land. The timber is ash, oak, elm, walnut, hickory, pecan, sycamore, cottonwood, and willow.

T. 1 N., R. 8 E. (*Chickasaw Nation*).—Two-thirds of the area of this fractional township is wooded.

T. 2 N., R. 8 E. (*Chickasaw Nation*).—This fractional township is about one-half rolling wooded land. The principal timber is oak, ash, elm, hickory, and walnut.

T. 3 N., R. 8 E. (Chickasaw Nation).—This fractional township is about one-half wooded.

T. 4 N., R. 8 E. (Chickasaw Nation).—This fractional township is rolling and nearly all wooded land. The principal timber is oak and hickory, with elm, hackberry, and walnut on the creeks.

T. 5 N., R. 8 E. (Chickasaw Nation).—The land is rolling and wooded, with oak and hickory timber, except in the bottom lands of the Canadian River, which are covered with oak, elm, ash, sycamore, and walnut timber.

Townships 1–5 South, Ranges 1–4 East.

T. 1 S., R. 1 E.—The timber is principally along the creeks, and consists of oak, elm, pecan, and hickory.

T. 2 S., R. 1 E.—The timber, which is found along the creeks, consists of oak, elm, ash, and sycamore.

T. 3 S., R. 1 E.—The southern portion is timbered with oak, elm, pecan, and hickory. The northern portion contains some prairie, with timber principally along the streams.

T. 4 S., R. 1 E.—The timber is oak, elm, and hickory.

T. 5 S., R. 1 E.—The timber is principally oak, elm, and hickory.

T. 1 S., R. 2 E.—The township is timbered near the river and its branches; about one-fourth is prairie. Oak, sycamore, cottonwood, ash, elm, and pecan of good quality are found in the bottoms.

T. 2 S., R. 2 E.—Only that portion of the township along the Washita River which is not under cultivation and along the creeks is timbered. Oak, pecan, elm, and ash are found in the bottoms, while a scattering growth of oak and hickory is found in the hills.

T. 3 S., R. 2 E.—More than one-half the township is timbered. The timber, which is of poor quality, consists of oak, hickory, and elm.

T. 4 S., R. 2 E.—The western part of the township is prairie, while the remainder, which is not in cultivation, is covered with a scrubby growth of oak and elm, both of which are of poor quality.

T. 5 S., R. 2 E.—About two-thirds of the township is wooded. The timber, consisting of oak, hickory, and pecan, is of fair quality.

T. 1 S., R. 3 E.—One-third of the township is well timbered with oak, elm, and hickory. Along the streams is found an abundant growth of walnut, sycamore, ash, and pecan timber, which is of little value commercially.

T. 2 S., R. 3 E.—Timber grows only along the creeks and branches in this township, in the eastern part. In the western and mountainous part, the timber, which is dense, consists of oak, elm, and hickory.

T. 3 S., R. 3 E.—The land in the Washita Valley is covered with a dense growth of oak, elm, ash, walnut, alder, pecan, hackberry, and hickory timber, with underbrush of same.

T. 4 S., R. 3 E.—The soil is light and sandy, covered with a dense growth of oak and hickory timber, with undergrowth of same. The timber in the valleys consists of oak, ash, elm, hackberry, hickory, sycamore, and pecan, with dense underbrush.

T. 5 S., R. 3 E.—Nearly all timbered. The northeast portion of this township is somewhat rough and is covered with a dense growth of oak, elm, and hickory timber, with underbrush.

T. 1 S., R. 4 E.—The township is nearly all prairie, except along the streams, which are skirted with oak timber.

T. 2 S., R. 4 E.—The township is nearly all prairie, except along the streams, where oak and pecan timber of no commercial value is found.

T. 3 S., R. 4 E.—The streams are nearly all skirted with timber and there is some timber in the southwest corner. The timber is oak, hickory, and elm of little commercial value.

T. 4 S., R. 4 E.—The timber along the river bottom consists of oak, walnut, pecan, cottonwood, and elm, none of which is of commercial value.

T. 5 S., R. 4 E.—The timber, covering about one-half of the township, consists of oak and hickory of little value.

Townships 6–9 South, Ranges 1–4 East.

T. 6 S., R. 1 E.—There is an abundant growth of oak, elm, and hickory in the northern and central portions of the township, while the southern part is prairie.

T. 7 S., R. 1 E.—The bottom land along Red River is heavily timbered.

T. 8. S., R. 1 E.—Considerable oak, elm, cottonwood, pecan, ash, and hickory timber is found throughout the township and along Red River and its numerous branches.

T. 9 S., R. 1 E.—This township is low and flat and heavily wooded. The timber is oak, ash, hackberry, and walnut.

T. 6 S., R. 2 E.—There is considerable oak, elm, hickory, and hackberry timber found along Anadarko and Hickory Creek and their numerous branches.

T. 7 S., R. 2 E.—Timber in this township is principally along the northern boundary, and consists of oak, hackberry, and elm.

T. 8 S., R. 2 E.—The northwestern portion of this township is prairie; the balance is covered with a dense growth of post oak and black-jack, with some hickory.

T. 9 S., R. 2 E.—Nearly all wooded.

T. 10 S., R. 2 E.—The timber in this fractional township consists of oak, elm, cottonwood, pecan, and hickory.

T. 6 S., R. 3 E.—Oak, elm, ash, pecan, and hickory, with dense undergrowth, are found in nearly all parts of this township.

T. 7 S., R. 3 E.—The surface of this township is rolling and heavily wooded with the exception of the southwestern portion, which is prairie.

T. 8 S., R. 3 W.—A considerable portion of this township is under cultivation. That which is not is generally covered with a dense growth of scrub oak and undergrowth of green briers.

T. 6 S., R. 4 E.—The eastern sections of this township are under cultivation; the remaining portion is rolling and broken wooded land. The timber is of poor quality and consists principally of oak and elm.

T. 7 S., R. 4 E.—The timber consists of oak, elm, ash, sycamore, and cottonwood.

T. 8 S., R. 4 E.—There is considerable oak, cottonwood, elm, and cedar timber along the banks of Red River.

TOWNSHIPS 1–5 SOUTH, RANGES 5–8 EAST.

T. 1 S., R. 5 E.—The timber along the streams consists of oak, elm, ash, walnut, and pecan of little value commercially.

T. 2 S., R. 5 E.—The northwestern portion is nearly all prairie, while the remainder is covered with oak, elm, pecan, and black-jack timber. Rock Creek and Pennington Creek are timbered with sycamore, cottonwood, ash, pecan, and walnut.

T. 3 S., R. 5 E.—About two-thirds of this township is wooded land. The timber covering the township consists of oak and elm, while along the streams are found oak, elm, ash, sycamore, and walnut of little value commercially.

T. 4 S., R. 5 E.—The timber covering nearly all of the township is principally oak and elm. That in the bottom land is cottonwood, walnut, ash, hickory, and sycamore of little value commercially.

T. 5 S., R. 5 E.—The greater part of the township is open prairie, with oak, elm, and pecan timber along the streams and on Glasses Creek, which drains the central and southeastern portion.

T. 1 S., R. 6 E.—Oak, ash, pecan, hickory, walnut, sycamore, cottonwood, and bois d'arc are found along the creek bottoms, and oak, hickory, and elm on the uplands along the eastern boundary. There is a sawmill in section 12.

T. 2 S., R. 6 E.—About one-fourth of the township is wooded. The timber consists of oak, ash, hickory, elm, hackberry, and pecan, and is found principally along the creek bottoms.

T. 3 S., R. 6 E.—The timber is oak, hickory, and elm on the uplands; oak, hickory, elm, sycamore, ash, and hackberry in the bottoms.

T. 4 S., R. 6 E.—The southwestern corner of the township is rolling prairie; nearly all of the remainder is wooded land. Oak, pecan, hickory, elm, sycamore, cottonwood, bois d'arc, and walnut are found along the Washita River and creeks.

T. 5 S., R. 6 E.—Only that portion bordering on the Washita

River and branches are timbered. Oak, elm, ash, hickory, pecan, and sycamore are found and are of good quality.

T. 1 S., R. 7 E.—There is a heavy growth of timber in the southwestern portion, consisting of oak, elm, ash, pecan, walnut, bois d'arc, hackberry, and hickory. Most of the water courses in the prairie portion are skirted with oak, elm, ash, and bois d'arc timber. A sawmill is located in section 32.

T. 2 S., R. 7 E.—A portion of this township is rolling prairie, with scattered timber. The northern portion is broken and rolling, wooded with oak and hickory. Ash, elm, walnut, hackberry, and bois d'arc are found on the banks of Blue River and the creeks.

T. 3 S., R. 7 E.—This township has a rolling surface, covered with ash and hickory timber. Along the banks of Blue River are found ash, elm, walnut, sycamore, hackberry, cottonwood, pecan, and bois d'arc.

T. 4 S., R. 7 E.—The northern portion of this township is rolling, and covered with oak and hickory timber; the southwestern portion is low bottom land, covered with a dense growth of ash, elm, oak, walnut, pecan, hickory, hackberry, locust, and bois d'arc, while the southeastern portion is not timbered.

T. 5 S., R. 7 E.—Oak and hickory are found on creeks. A level bottom is found on the Washita River, which is heavily timbered with oak, elm, pecan, ash, hickory, hackberry, sycamore, cottonwood, and bois d'arc.

T. 1 S., R. 8 E. (*Chickasaw Nation*).—This township is partly rolling timbered land. The timber consists of oak, ash, elm, hickory, and bois d'arc.

T. 2 S., R. 8 E. (*Chickasaw Nation*).—This township is high, rolling land with a scattering growth of oak and elm timber.

T. 3 S., R. 8 E. (*Chickasaw Nation*).—This township is nearly all wooded land. The principal timber is oak, hickory, and elm.

T. 4 S., R. 8 E. (*Chickasaw Nation*).—The central portion of this township is level bottom, heavily timbered with oak, elm, ash, pecan, walnut, hickory, hackberry, and bois d'arc. The northern portion is rolling and is covered with oak and hickory.

T. 5 S., R. 8 E. (*Chickasaw Nation*).—The land is prairie, with narrow belts of timber along the streams. The principal kinds of timber are oak, elm, bois d'arc, ash, hickory, and sycamore. Only the bois d'arc is of any value commercially.

TOWNSHIPS 6–8 SOUTH, RANGES 5–7 EAST; TOWNSHIPS 6–9 SOUTH, RANGE 8 EAST; TOWNSHIPS 8–10 SOUTH, RANGES 9–11 EAST.

T. 6 S., R. 5 E.—The only timber is oak, ash, elm, and pecan, along the creeks.

T. 7 S., R. 5 E.—This township is rolling timbered land, except a small portion in the northern half, which is stony prairie. The timber is oak, elm, and hickory, fit only for fuel and fencing.

T. 8 S., R. 5 E.—The land is generally rolling and level and covered with a dense growth of oak, elm, and hickory, with underbrush.

T. 6 S., R. 6 E.—Most of the water courses are timbered with oak, elm, ash, hickory, hackberry, walnut, pecan, bois d'arc, sycamore, and cottonwood.

T. 7 S., R. 6 E.—Timber is oak, elm, cottonwood, hickory, and sycamore.

T. 8 S., R. 6 E.—Nearly all of this fractional township is heavily timbered with a dense growth of oak, elm, ash, walnut, haw, sycamore, cottonwood, hickory, and pecan, with underbrush.

T. 6 S., R. 7 E.—Timber, consisting of oak, elm, and hickory, is found over nearly all the township. Ash, cottonwood, and sycamore are found scattered along the Washita River and several small creeks.

T. 7 S., R. 7 E.—The timber, covering three-fourths of the township, consists of oak, ash, elm, hickory, cottonwood, and sycamore. Cottonwood and sycamore are found only along the streams.

T. 8 S., R. 7 E.—Timber consists of oak, elm, and hickory on the rolling land and bois d'arc, ash, walnut, sycamore, mulberry, willow, and pecan, with dense growth of underbrush and briers, on the bottom land.

T. 6 S., R. 8 E. (*Chickasaw Nation*).—The timber consists of oak, elm, hickory, and pecan.

T. 7 S., R. 8 E. (*Chickasaw Nation*).—Timber is oak, elm, and hickory.

T. 8 S., R. 8 E. (*Chickasaw Nation*).—Timber consists of oak, elm, ash, and hickory.

T. 9 S., R. 8 E. (*Chickasaw Nation*).—The timber consists of oak, elm, pecan, hackberry, hickory, ash, and cottonwood.

T. 8 S., R. 9 E.—A portion of this township is gently rolling, wooded land. The timber is principally oak, elm, ash, and hickory, with the addition of sycamore and cottonwood along the streams.

T. 9 S., R. 9 E.—The timber is oak, ash, elm, hickory, sycamore, and cottonwood.

T. 10 S., R. 9 E.—The timber is ash, oak, elm, cottonwood, sycamore, and willow.

T. 8 S., R. 10 E. (*Chickasaw Nation*).—This fractional township is about one-half wooded.

T. 9 S., R. 10 E.—The timber consists of oak, elm, cottonwood, sycamore, and bois d'arc.

T. 10 S., R. 10 E.—The timber in this small fractional township consists of oak, ash, elm, sycamore, cottonwood, and willow.

T. 8 S., R. 11 E.—This fractional township is nearly all wooded.

T. 9 S., R. 11 E.—The timber is hackberry, hickory, ash, elm, cottonwood, oak, sycamore, and mulberry

TIMBER CONDITIONS OF THE PINE REGION OF MINNESOTA

BY

H. B. AYRES

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ILLUSTRATION.

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Plate CXLIII. Map of the pine region of Minnesota, showing classification of lands........ In atlas.

TIMBER CONDITIONS OF THE PINE REGION OF MINNESOTA.

By H. B. Ayres.

BOUNDARIES.

The pine lands of Minnesota, as indicated by the earliest surveys, extended to the State line on the north and east, while southward they merged into the hardwood "park region" along the southern lines of Pine and Kanabec counties. Thence westward the irregular border passed near Milaca, Little Falls, and Wadena to Frazer City and northward to the western extremities of Red Lake and Lake of the Woods.

SPECIES.

The trees composing this forest are:

Species found in pine region of Minnesota.

White pine	Pinus strobus Linn.
Jack pine	Pinus divaricata (Ait.) Du Mont de Cours.
Norway or red pine	Pinus resinosa Ait.
Tamarack	Larix laricina (Du Roi) Koch.
White cedar	Thuja occidentalis Linn.
Red cedar	Juniperus virginiana Linn.
Black spruce	Picea mariana (Mill.) B. S. P.
White spruce	Picea canadensis (Mill.) B. S. P.
Balsam	Abies balsamea (Linn.) Mill.
Hemlock	Tsuga canadensis (Linn.) Carr.
Aspen	Populus tremuloides Michx.
White poplar	Populus grandidentata Michx.
Balm of Gilead	Populus balsamifera Linn.
White birch	Betula papyrifera Marsh.
Yellow birch	Betula lutea Michx. f.
Hard maple	Acer saccharum Marsh.
Red maple	Acer rubrum Linn.
White maple	Acer saccharinum Linn.
Basswood	Tilia americana Linn.
Red oak	Quercus rubra Linn.
Burr oak	Quercus macrocarpa Michx.
White oak	Quercus alba Linn.
Scarlet oak	Quercus coccinea Muenchh.

Black ash	Fraxinus nigra Marsh.
White ash	Fraxinus americana Linn.
White elm	Ulmus americana Linn.
Rock elm	Ulmus racemosa Thomas.
Slippery elm	Ulmus pubescens Walt.
Ironwood	Ostrya virginiana (Mill.) Koch.
Hackberry	Celtis occidentalis Linn.
Butternut	Juglans cinerea Linn.
Hickory (pig nut)	Hicoria minima (Marsh.) Britton.
Black cherry	Prunus serotina Ehrh.

TIMBER TREES.

The trees now used for lumber are, in order of the amounts cut:

Timber trees in pine region of Minnesota.

1. White pine.
2. Norway pine.
3. Burr oak.
4. White spruce.
5. Jack pine.
6. White elm.
7. Tamarack.
8. Basswood.
9. Yellow birch.
10. Hard maple.
11. White poplar.
12. Rock elm.

Of these twelve, but three, white pine, Norway pine, and burr oak, have been of commercial importance.

Tamarack has been extensively used for railway ties. Cedar is used in large quantity for poles, posts, and ties. A small amount of jack pine is cut and sold with Norway pine as lumber and many ties are made of it for branch railroads, but its principal use is for fuel.

Spruce and a small quantity of aspen are used for pulp.

Yellow birch, hard maple, basswood, ash, etc., are utilized for lumber when accessible, but trees suitable for lumber are much scattered, and until recently land owners or buyers have paid little attention to hardwood.

Most lumbermen have ignored everything but pine, but some have estimated it in cords as fuel.

DISTRIBUTION.

The trees have their preferences as to soil, subsoil, and exposure, but there is so little difference in large areas and so much variety on almost every 40-acre tract that, excepting the larger tracts of sandy lands and muskegs, the classes are so intermingled that they can not be differentiated on a map.

White pine, like all other trees, grows best in deep, porous, moist, fertile soil, and in this region the effect of the climate and the fires have often enabled it to establish itself on the best of the land in competition with species which in milder climate and freedom from fires would have crowded it out.

While Norway pine and jack pine enjoy good soil, they find most favorable starting places on sandy and gravelly lands, occasionally fire-swept, such as the triangular tract of which Sturgeon Lake is the center and the large crescent-shaped area extending from Brainerd to Red Lake.

Burr oak also likes a porous soil and is found as a timber tree on the borders of the pine land and on alluvial banks and bottoms. On shallow soils, with hard clay subsoils, this species becomes a scrub oak, notably on the bowlder clays west of Park Rapids. Basswood and maple are found on the very best uplands. Yellow birch, red oak, aspen, white birch, and others are found on the medium quality or inferior clay lands. Tamarack thrives on the loamy borders of swamps, while black spruce is seldom found on dry land, but usually borders and reaches out slightly upon the muskegs.

Within the borders indicated the only natural treeless areas are muskegs or swamps and the few small prairie openings or parks in the western portion.

EXPLANATION OF MAP.

A very prominent feature of the Minnesota pine forest is its variety. The so-called original forest, or the forest found by the earliest whites, was a complicated patchwork of kinds and conditions due to a great variety of surface and soil, to the ceaseless strife between the thirty-nine species of trees composing it, and to the effect of ever-varying fires. Incidentally, the white man has greatly increased this variety of conditions by cutting, burning, and clearing.

Some of the lines between the differing classes of forest are sharp and distinct, but most of them are indefinite. Some areas of each class are extensive, but many of them are very small and irregular in outline.

To make a map showing such small details and such interlapping and blending areas is impractical, not only because of the impossibility of printing such a map, but also because of the expense of collecting such minute data. Furthermore it would not be good policy to publish a statement of the amounts and exact locations of standing timber which timber thieves could use. Therefore the information collected has been generalized to show the proportions of original forest remaining, the approximate amount of standing pine timber, the areas of stump land, and the land burned before cutting.

In presenting this information on the map the principal color has been used to represent the more important feature of the forest and the subordinate colors to show as nearly as possible the proportion of the classes they each represent.

For example, a township is reported as cut over, with 10,000,000 feet of pine left. This township is colored yellow and dotted with green, the green representing not the exact location but the general proportion of standing timber. Again, where lines in the forest are indefinite, and classes blend or natural borders fade into one another, the lines must on the map be drawn sharp in order to print them. The details of the actual condition are thus lost, but the proportions are believed to be approximately correct.

An unavoidable source of inaccuracy lies in the fact that some of the land has not been thoroughly explored and estimated. Some thirty townships are yet unsurveyed, and while they have been looked over in a general way by timbermen, the estimates do not cover all the land, and are intended to be less than the actual cut or "safe estimates."

Former estimates of the amount of pine-log timber in the State have been small for the same reason. The amounts stated were the amounts known, and a large discrepancy often occurred in making allowance for the unexplored areas. It is quite possible that the present estimate may prove less than the cut, especially if fires are effectually checked and natural growth be permitted to increase by normal annual accretions the size of the trees now standing.

ESTIMATES.

In making up the present estimate it was found that the county records were of no use, but were rather misleading, with the few exceptions where special assessments had been made, as in parts of Itaska, Hubbard, and Lake counties. Large areas were found assessed at a uniform valuation, ranging from $1 to $3 per acre, whether timbered or stump land, pine, hardwood, or open bog.

The areas assigned to assessors are often so large that it is impossible for them to make a proper estimate of timber with the funds set apart for their remuneration.

The reports of lumbermen and pine-land owners have been equally unsatisfactory for several reasons. Their lands are not in large, continuous tracts, but are isolated selected 40-acre lots, chosen on account of the pine on them from the lands vacant or purchasable at the time. Being picked areas, they do not represent the average, and their estimates can apply only to the tracts on which they were made.

A serious difficulty was due to the great number of small holdings and the distant residence of the owners. This, combined with their business reasons for not making known the amount of pine on their lands, has rendered the collection of data from the owners impractical.

The most satisfactory class of information has been that furnished by cruisers who have estimated standing timber or looked after cutting in their several regions. The estimates obtained from them have not in all cases been a summary of their own cruisings, but are partly rough estimates, based on their general knowledge, in order to cover the intermediate ground they have not cruised.

The need of careful estimates and appraisals by township assessors, in order to levy a just taxation and furnish accurate knowledge of the forest, is keenly felt by the owners and other taxpayers as well as by those who are studying the maintenance of the forest.

In the following table the attempt is made to show approximately the amount of forest material left in the pine region. In preparing it especial care was taken to avoid making estimates on an imperfect basis, such as applying an average of lands held by one person (selected areas) to any large contiguous area. Openings, swamps, sapling and hard-wood tracts must be averaged with these selected areas to secure a fair factor for the whole region.

Table showing timber remaining in pine region of Minnesota.

County.	Log timber (million ft. B. M.).			Pulp wood (thousand cords).		Fuel (thousand cords).	
	White pine.	Norway pine.	Hard wood.	Spruce.	Aspen.	Hard.	Soft.
Cook	900	100	500	500	1,000	5,000	900
Lake	1,400	1,000	500	1,000	3,000	10,000	1,000
St. Louis	3,440	1,500	650	3,000	8,200	18,000	2,000
Itasca	1,500	800	400	3,000	8,000	17,000	3,000
Beltrami	1,400	500	200	1,000	4,000	8,000	2,000
Norman	50	10	5	1	100	280	20
Becker	230	50	30	5	400	2,000	500
Ottertail	3	2	80	.5	100	800	10
Wadena	6	12	10	1	50	1,000	10
Hubbard	300	350	10	1	1,000	1,000	3,010
Cass	850	300	100	500	2,000	1,000	5,000
Crow Wing	40	20	20	200	2,000	1,000	3,000
Aitkin	160	40	50	1,000	3,000	10,000	1,000
Carlton	250	50	30	70	500	2,000	800
Pine	450	50	30	30	400	3,000	700
Kanabec	70	10	10	10	200	1,000	200
Millelacs	130	20	110	5	100	1,000	300
Morrison	10	4	45	5	130	500	800
Benton	1	1	10	....	2	1,100	....
Total	11,190	4,819	2,780	10,328.5	34,182	73,680	24,250

In comparison with the estimate of standing timber made by the Minnesota chief fire warden in his annual report for the year 1896, viz, white and Norway pine, 20,666,475,000 feet B. M., the present estimate for 1899 of 16,009,000,000 feet B. M. is less by 4,257,475,000 feet B. M. This difference is not far from the cut of the intervening years, and as these two estimates were made independently by summing detailed data collected by extensive canvass, it seems that the amount of standing timber has been learned as accurately as possible by the methods employed. As suggested elsewhere in this article, township assessors might, at small additional cost in making their assessments, collect such data and make our knowledge of such lands much more accurate. The estimate would thus be revised with each assessment.

CLASSIFICATION OF FOREST LAND.

The following table serves to show the general condition of the forest with reference to cutting and burning, with the explanation that about 90 per cent of the stump lands are burned and that much of the so-called virgin forest has been burned and is now in the various stages of restocking. Much of this area is mere brush, and some of it is open slough, muskeg, or meadow, which it has been impracticable to separate.

Large areas have been burned over and large amounts of log timber have been killed and lost, of which there is no record and no evidence. The fires occurred years ago and these lands are now classed as cut over, because the timber trees that survived have since been cut.

Classification of forest land in pine region of Minnesota.

County.	Original forest.	Stump lands.	Known to have been burned before cutting.
	Square miles.	*Square miles.*	*Square miles.*
Cook	1,277	4	240
Lake	2,237	90	230
St. Louis	2,520	1,810	2,232
Itasca	3,744	1,160	576
Beltrami	924	400	2,160
Norman	20	....	144
Becker	108	430	216
Ottertail	None.	260	Not recorded.
Wadena	None.	400	40
Hubbard	228	500	324
Cass	504	1,260	400
Crow Wing	20	1,080	Not recorded.
Aitkin	70	1,800	Not recorded.
Carlton	55	790	*a* 14
Pine	63	1,000	Not recorded.
Kanabec	20	580	Not recorded.
Millelacs	82	280	Not recorded.
Morrison	10	400	Not recorded.
Benton	None.	40	Not recorded.
Total	11,882	12,684	....

a Partly recorded.

FOREST HISTORY.

Where undisturbed by cutting, the forest of to-day differs from that of a hundred years ago only as affected directly or indirectly by fire. The oldest woods are fire scattered, especially where composed of young or middle-aged pine, having large trees scattered among it. These large trees have almost invariably been marked by fire at a date older than the younger portion of the forest.

In the so-called original forest the scarred veterans of old fires standing high above the common woods form a prominent feature of the landscape.

Only a portion of the old burns were restocked with pine, however, for large areas severely burned and without seed trees were occupied by aspen and birch and are as yet very scantily timbered.

FIRES.

Thus it is seen that fires are not a novelty in these old woods, but have for hundreds of years been a prominent factor in their history. The coming of the whites and the general distribution of trappers and "couriers du bois" through the woods by the Hudson Bay Company and the American Fur Company 100 to 140 years ago seem to have been prolific of fires, for a very large proportion of the trees of the older uniform forests are 100 to 140 years of age, and must have started during that period. Later fires, especially those of 1840 north of Red Lake, those of 1860 and 1878 northeast of Tower, and the general fire of 1894, have been very destructive, and since lumbering began large areas untouched by the ax have been reduced by fire to brush land, on which stubs and stumps of the former forest are abundant.

In the Seventh Annual Report of the Geological and Natural History Survey of Minnesota, Prof. N. H. Winchell says:

> During the season [1878] all parties connected with the survey have had occasion to note the frequent and wanton destruction of the native forests by fire. It is estimated that annually ten times as much pine is destroyed in the State as is cut by all the mills. A large part of the triangle north of Lake Superior has been thus devastated. The State has lost in this way more than as much pine as now remains.

On the western border of the pine forest from Red Lake to Becker County and southeastward to Brainerd, fires have been frequent and severe. In this region pine is usually found in clumps that have escaped the killing fires. The trees in these clumps are scorched and partly killed, while the intermediate areas are open and brushy, with many remains of large pine trees. The amount of pine log timber lost by these fires has been enormous, even within the memory of lumbermen. Where accessible, much of the log timber can be used immediately after being killed by fire, but in remote and undeveloped territory losses have been very heavy, as the timber killed has necessarily been wasted. Only a small proportion of such losses has been estimated or recorded, but the following notes illustrate some of the damage:

Damage from fire in pine region of Minnesota.

Date.	Locality.	Killed.
		Feet B. M.
1889	T. 144 N., R. 39 W	25,000,000
1894	T. 148 N., R. 38 W	9,600,000
1894	T. 149 N., R. 38 W	55,740,000
Various fires	T. 143 N., R. 37 W	105,000,000
Do	T. 145 N., R. 38 W	10,000,000
Do	T. 144 N., R. 37 W	165,000,000
Do	T. 145 N., R. 37 W	55,000,000
Do	T. 146 N., R. 37 W	97,000,000
Do	T. 146 N., R. 38 W	25,000,000
Do	T. 144 N., R. 31 W	122,000,000
Do	T. 144 N., R. 32 W	22,000,000
Do	T. 144 N., R. 30 W	70,000,000
Do	T. 144 N., R. 29 W	45,000,000
Do	T. 144 N., R. 27 W	90,000,000

In these 14 townships there has been a known loss of 836 million feet, which to-day would have been worth on the stump $3,344,000, or an average of some $240,000 to each township.

Fires have been very destructive in the northern part of the State also. A large proportion of the area north of Red Lake and eastward to Lake Superior (several thousand square miles) has been reduced to brush land, and several thousand acres are now bare rock on which dead stubs and partly burned roots show that timber once grew. The areas burned over, killing the timber before cutting, are now undeterminable. Those now known and shown on the map are but a fraction of the whole. The area of these amounts to about 4,760 square miles. There is no way of closely estimating this amount. Roughly, it may be assumed that this land averaged probably 2,000 feet per acre, or 1,280,000 feet per square mile. The amount killed was probably 8 billion feet.

In considering the damage by fires it should be remembered that only a small portion of severely burned lands are soon restocked with timber trees. This fact is illustrated by the condition of the old forest, most of which was probably seeded on burns. The yield on such land seldom exceeds 10,000 feet B. M. per acre (though 100,000 feet have been cut on exceptional acres), and there are large areas that do not average more than 1,000 feet per acre. Some 14,000 square miles of original forest in the northern part of the State will not average 3,000 feet of pine per acre, and it is probable that the average yield for the whole pine region has been about this figure. The difference between this figure and 10,000 feet per acre, which would be only a moderate possible stand for white and Norway pine, may with reason be attributed to the effect of fires.

FIRES ON STUMP LAND.

Stump land is seldom found unburned. It is roughly estimated that 90 per cent of the cut-over land in the State has been overrun by fire. In such burning most of the seeds, seedlings, and seed trees are killed.

Where fires have been moderate and some seed trees survived, a new stand of pine sometimes appears, but where severe the fires are followed by aspen, birch, scrub pine, or brush.

The loss in burning stump land is usually greatly underestimated. Much of the land immediately after cutting has many saplings, which in a few years would make timber and seed trees. Fires kill these and render the land nonproductive, or at least greatly reduce the product.

Perhaps the best way to estimate the damage is to consider the difference between fairly stocked land yielding 10,000 feet per acre and fire-swept land yielding nothing. About one hundred years are required to produce a crop of 10,000 feet per acre. This means an average annual growth of 100 feet B. M., or 40 cents' worth of log timber, per acre each year, besides fuel, etc. This amount, though small, is in contrast with lands going delinquent for taxes, the common rate of taxation being about 7½ cents per acre. In the pine region of the State there are about 1,000,000 acres of land on which taxes are delinquent.

In tabulating the delinquent lists it is quite noticeable that a great proportion of delinquent lands are in the old pineries, where soil is light. The delinquent lands in Cass County number 116,000 acres; in Crow Wing County, 68,000 acres, and in Millelacs County, 80,000 acres. Where exhausted forests and collapsed real estate booms have both occurred the highest proportion is found, as in Carlton County, where the delinquent lands amount to 106,000 acres, or nearly 20 per cent of the area of the county.

FIRE PROTECTION.

The present system of fire protection is unquestionably a great check upon fire, but the few years that have passed since its inauguration are not sufficient to show exactly what its effect will be after the fear of the people, excited by the fires of 1894, subsides and a very dry season occurs. The present system is too much under local influence.

NEW GROWTH.

On burned stump land the principal stock is aspen. Among this are white birch and scrub pine, with other species and brush in mixture. The reappearance of white and Norway pine on severe burns is rather unusual.

VALUE OF STUMP LAND.

In considering the value of stump land, a comparative view of the areas cut over, the areas improved, and the areas on which taxes are delinquent serves to show the waste or misuse of land that might be growing timber until needed for agriculture.

Comparative table showing use of stump land in the pine region of Minnesota.

County.	Areas of pine forest.	Areas cut over.	Areas assessed as improved.	Areas on which taxes are delinquent.
	Square miles.	*Square miles.*	*Square miles.*	*Square miles.*
Cook	1,520	4	....	....
Lake	2,380	90	0.42	15.68
St. Louis	5,860	1,810	8.84	134.37
Itasca	5,430	1,160	19.62	113.62
Beltrami	5,040	400	.39	31.60
Becker	720	430	131.40	[a]99.28
Ottertail	260	260	....	....
Wadena	460	400	55.23	[a]35.12
Hubbard	1,000	500	117.19	25.06
Cass	2,990	1,260	9.30	179.75
Crow Wing	550	1,080	33.40	103.25
Aitkin	1,900	1,800	....	110.68
Carlton	860	790	115.00	163.81
Pine	1,400	1,000	....	77.56
Kanabec	522	580	6.70	16.56
Todd	280	280	....	....
Millelacs	580	400	....	121.56
Morrison	400	400	135.10	80.62
Benton	40	40	73.35	35.30
Total	32,192	12,684	....	....

[a] Mostly agricultural.

It should be remembered that not all the improved lands are assessed as improved; only those that have been deeded from the Government. On the other hand, in the forest the areas of improved lands not deeded are very small; seldom over 3 acres; merely a garden patch.

With this table it would be very interesting to compare the areas of entered lands and to note the great discrepancy between the amount of forest land bought or entered (much of it "homesteaded") by individuals and the amount actually improved by agricultural use.

Of the land from which the timber has been cut off 90 per cent is burned over and lies waste, while the remainder is utilized in agriculture.

If forest land is to be farmed, the farming should begin immediately after cutting, as with such practice the land would not lie idle, and that would be the easiest time to clear the land.

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136. Volcanic Rocks of South Mountain, Pennsylvania, by Florence Bascom. 1896. 8°. 124 pp. 28 pl. Price 15 cents.

137. The Geology of the Fort Riley Military Reservation and Vicinity, Kansas, by Robert Hay. 1896. 8°. 35 pp. 8 pl. Price 5 cents.

138. Artesian-Well Prospects in the Atlantic Coastal Plain Region, by N. H. Darton. 1896. 8°. 228 pp. 19 pl. Price 20 cents.

139. Geology of the Castle Mountain Mining District, Montana, by W. H. Weed and L. V. Pirsson. 1896. 8°. 164 pp. 17 pl. Price 15 cents.

140. Report of Progress of the Division of Hydrography for the Calendar Year 1895, by Frederick Haynes Newell, Hydrographer in Charge. 1896. 8°. 356 pp. Price 25 cents.

141. The Eocene Deposits of the Middle Atlantic Slope in Delaware, Maryland, and Virginia, by William Bullock Clark. 1896. 8°. 167 pp. 40 pl. Price 15 cents.

142. A Brief Contribution to the Geology and Paleontology of Northwestern Louisiana, by T. Wayland Vaughan. 1896. 8°. 65 pp. 4 pl. Price 10 cents.

143. A Bibliography of Clays and the Ceramic Arts, by John C. Branner. 1896. 8°. 114 pp. Price 15 cents.

144. The Moraines of the Missouri Coteau and their Attendant Deposits, by James Edward Todd. 1896. 8°. 71 pp. 21 pl. Price 10 cents.

145. The Potomac Formation in Virginia, by W. M. Fontaine. 1896. 8°. 149 pp. 2 pl. Price 15 cents.

146. Bibliography and Index of North American Geology, Paleontology, Petrology, and Mineralogy for the Year 1895, by F. B. Weeks. 1896. 8°. 130 pp. Price 15 cents.

147. Earthquakes in California in 1895, by Charles D. Perrine, Assistant Astronomer in Charge of Earthquake Observations at the Lick Observatory. 1896. 8°. 23 pp. Price 5 cents.

148. Analyses of Rocks, with a Chapter on Analytical Methods, Laboratory of the United States Geological Survey, 1880 to 1896, by F. W. Clarke and W. F. Hillebrand. 1897. 8°. 306 pp. Price 20 cents.

149. Bibliography and Index of North American Geology, Paleontology, Petrology, and Mineralogy for the Year 1896, by Fred Boughton Weeks. 1897. 8°. 152 pp. Price 15 cents.

150. The Educational Series of Rock Specimens Collected and Distributed by the United States Geological Survey, by Joseph Silas Diller. 1898. 8°. 400 pp. 47 pl. Price 25 cents.

151. The Lower Cretaceous Gryphæas of the Texas Region, by R. T. Hill and T. Wayland Vaughan. 1898. 8°. 139 pp. 35 pl. Price 15 cents.

152. A Catalogue of the Cretaceous and Tertiary Plants of North America, by F. H. Knowlton. 1898. 8°. 247 pp. Price 20 cents.

153. A Bibliographic Index of North American Carboniferous Invertebrates, by Stuart Weller. 1898. 8°. 653 pp. Price 35 cents.

154. A Gazetteer of Kansas, by Henry Gannett. 1898. 8°. 246 pp. 6 pl. Price 20 cents.

155. Earthquakes in California in 1896 and 1897, by Charles D. Perrine, Assistant Astronomer in Charge of Earthquake Observations at the Lick Observatory. 1898. 8°. 47 pp. Price 5 cents.

156. Bibliography and Index of North American Geology, Paleontology, Petrology, and Mineralogy for the Year 1897, by Fred Boughton Weeks. 1898. 8°. 130 pp. Price 15 cents.

157. The Gneisses, Gabbro-Schists, and Associated Rocks of Southwestern Minnesota, by Christopher Webber Hall. 1899. 8°. 160 pp. 27 pl. Price 45 cents.

158. The Moraines of Southeastern South Dakota and their Attendant Deposits, by James Edward Todd. 1899. 8°. 171 pp. 27 pl. Price 25 cents.

159. The Geology of Eastern Berkshire County, Massachusetts, by B. K. Emerson. 1899. 8°. 139 pp. 9 pl. Price 20 cents.

160. A Dictionary of Altitudes in the United States (Third Edition), compiled by Henry Gannett. 1899. 8°. 775 pp. Price 40 cents.

161. Earthquakes in California in 1898, by Charles D. Perrine, Assistant Astronomer in Charge of Earthquake Observations at the Lick Observatory. 1899. 8°. 31 pp. 1 pl. Price 5 cents.

162. Bibliography and Index of North American Geology, Paleontology, Petrology, and Mineralogy for the Year 1898, by Fred Boughton Weeks. 1899. 8°. 163 pp. Price 15 cents.

163. Flora of the Montana Formation, by Frank Hall Knowlton. 1900. 8°. 118 pp. 19 pl. Price 15 cents

164. Reconnaissance in the Rio Grande Coal Fields of Texas, by Thomas Wayland Vaughan, including a Report on Igneous Rocks from the San Carlos Coal Field, by E. C. E. Lord. 1900. 8°. 100 pp. 11 pl. and maps. Price 20 cents.

165. Contributions to the Geology of Maine, by Henry S. Williams and Herbert E. Gregory. 1900. 8°. 212 pp. 14 pl. Price 25 cents.

166. A Gazetteer of Utah, by Henry Gannett. 1900. 8°. 43 pp. 1 map. Price 15 cents.

167. Contributions to Chemistry and Mineralogy from the Laboratory of the United States Geological Survey; Frank W. Clarke, Chief Chemist. 1900. 8°. 166 pp. Price 15 cents.

168. Analyses of Rocks, Laboratory of the United States Geological Survey, 1880 to 1899, tabulated by F. W. Clarke, Chief Chemist. 1900. 8°. 308 pp. Price 20 cents.

169. Altitudes in Alaska, by Henry Gannett. 1900. 8°. 13 pp. Price 5 cents.

170. Survey of the Boundary Line between Idaho and Montana from the International Boundary to the Crest of the Bitterroot Mountains, by Richard Urquhart Goode. 1900. 8°. 67 pp. 14 pl. Price 15 cents.

171. Boundaries of the United States and of the Several States and Territories, with an Outline of the History of all Important Changes of Territory (Second Edition), by Henry Gannett. 1900. 8°. 142 pp. 53 pl. Price 30 cents.

172. Bibliography and Index of North American Geology, Paleontology, Petrology, and Mineralogy for the Year 1899, by Fred Boughton Weeks. 1900. 8°. 141 pp. Price 15 cents.

173. Synopsis of American Fossil Bryozoa, including Bibliography and Synonymy, by John M. Nickles and Ray S. Bassler. 1900. 8°. 663 pp. Price 40 cents.

174. Survey of the Northwestern Boundary of the United States, 1857–1861, by Marcus Baker. 1900. 8°. 78 pp. 1 pl. Price 10 cents.

175. Triangulation and Spirit Leveling in Indian Territory, by C. H. Fitch. 1900. 8°. 141 pp. 1 pl. Price 10 cents.

176. Some Principles and Methods of Rock Analysis, by W. F. Hillebrand. 1900. 8°. 114 pp. Price 15 cents.

In preparation:

—. Bibliography and Catalogue of the Fossil Vertebrata of North America, by Oliver Perry Hay.

WATER-SUPPLY AND IRRIGATION PAPERS.

By act of Congress approved June 11, 1896, the following provision was made:

"*Provided*, That hereafter the reports of the Geological Survey in relation to the gauging of streams and to the methods of utilizing the water resources may be printed in octavo form, not to exceed one hundred pages in length and five thousand copies in number; one thousand copies of which shall be for the official use of the Geological Survey, one thousand five hundred copies shall be delivered to the Senate, and two thousand five hundred copies shall be delivered to the House of Representatives, for distribution."

Under this law the following papers have been published:

1. Pumping Water for Irrigation, by Herbert M. Wilson. 1896. 8°. 57 pp. 9 pl.
2. Irrigation near Phœnix, Arizona, by Arthur P. Davis. 1897. 8° 97 pp. 31 pl.
3. Sewage Irrigation, by George W. Rafter. 1897. 8°. 100 pp. 4 pl.
4. A Reconnoissance in Southeastern Washington, by Israel Cook Russell. 1897. 8°. 96 pp. 7 pl.
5. Irrigation Practice on the Great Plains, by Elias Branson Cowgill. 1897. 8°. 39 pp. 12 pl.
6. Underground Waters of Southwestern Kansas, by Erasmuth Haworth. 1897. 8°. 65 pp. 12 pl.
7. Seepage Waters of Northern Utah, by Samuel Fortier. 1897. 8°. 50 pp. 3 pl.
8. Windmills for Irrigation, by E. C. Murphy. 1897. 8°. 49 pp. 8 pl.
9. Irrigation near Greeley, Colorado, by David Boyd. 1897. 8°. 90 pp. 21 pl.
10. Irrigation in Mesilla Valley, New Mexico, by F. C. Barker. 1898. 8°. 51 pp. 11 pl.
11. River Heights for 1896, by Arthur P. Davis. 1897. 8°. 100 pp.
12. Underground Waters of Southeastern Nebraska, by N. H. Darton. 1898. 8°. 56 pp. 21 pl.
13. Irrigation Systems in Texas, by William Ferguson Hutson. 1898. 8°. 67 pp. 10 pl.
14. New Tests of Pumps and Water-Lifts used in Irrigation, by O. P. Hood. 1898. 8°. 91 pp. 1 pl.
15. Operations at River Stations, 1897, Part I. 1898. 8°. 100 pp.
16. Operations at River Stations, 1897, Part II. 1898. 8° 101–200 pp.
17. Irrigation near Bakersfield, California, by C. E. Grunsky. 1898. 8°. 96 pp. 16 pl.

18. Irrigation near Fresno, California, by C. E. Grunsky. 1898. 8°. 94 pp. 14 pl.
19. Irrigation near Merced, California, by C. E. Grunsky. 1899. 8°. 59 pp. 11 pl.
20. Experiments with Windmills, by T. O. Perry. 1899. 8°. 97 pp. 12 pl.
21. Wells of Northern Indiana, by Frank Leverett. 1899. 8°. 82 pp. 2 pl.
22. Sewage Irrigation, Part II, by George W. Rafter. 1899. 8°. 100 pp. 7 pl.
23. Water-right Problems of the Bighorn Mountains, by Elwood Mead. 1899. 8°. 62 pp. 7 pl.
24. Water Resources of the State of New York, Part I, by G. W. Rafter. 1899. 8°. 99 pp. 13 pl.
25. Water Resources of the State of New York, Part II, by G. W. Rafter. 1899. 8°. 101–200 pp. 12 pl.
26. Wells of Southern Indiana (Continuation of No. 21), by Frank Leverett. 1899. 8°. 64 pp.
27. Operations at River Stations for 1898, Part I. 1899. 8°. 100 pp.
28. Operations at River Stations for 1898, Part II. 1899. 8°. 101–200 pp.
29. Wells and Windmills in Nebraska, by Erwin H. Barbour. 1899. 8°. 85 pp. 27 pl.
30. Water Resources of the Lower Peninsula of Michigan, by Alfred C. Lane. 1899. 8°. 97 pp. 7 pl.
31. Lower Michigan Mineral Waters, by Alfred C. Lane. 1899. 8°. 97 pp. 4 pl.
32. Water Resources of Puerto Rico, by Herbert M. Wilson. 1899. 8°. 48 pp. 17 pl.
33. Storage of Water on Gila River, Arizona, by Joseph B. Lippincott. 1900. 8°. 98 pp. 33 pl.
34. Geology and Water Resources of SE. South Dakota, by J. E. Todd. 1900. 8°. 34 pp. 19 pl.
35. Operations at River Stations, 1899, Part I. 1900. 8°. 100 pp.
36. Operations at River Stations, 1899, Part II. 1900. 8°. 101–198 pp.
37. Operations at River Stations, 1899, Part III. 1900. 8°. 199–298 pp.
38. Operations at River Stations, 1899, Part IV. 1900. 8°. 299–396 pp.
39. Operations at River Stations, 1899, Part V. 1900. 8°. 397–471 pp.

In preparation:

40. The Austin Dam, by Thomas U. Taylor.
41. Experiments with Windmills, by E. C. Murphy.
42. Conveyance of Water, by Samuel Fortier.
43. Profiles of Rivers, by Henry Gannett.

TOPOGRAPHIC MAP OF THE UNITED STATES.

When, in 1882, the Geological Survey was directed by law to make a geologic map of the United States, there was in existence no suitable topographic map to serve as a base for the geologic map. The preparation of such a topographic map was therefore immediately begun. About one-fifth of the area of the country, excluding Alaska, has now been thus mapped. The map is published in atlas sheets, each sheet representing a small quadrangular district, as explained under the next heading. The separate sheets are sold at 5 cents each when fewer than 100 copies are purchased, but when they are ordered in lots of 100 or more copies, whether of the same sheet or of different sheets, the price is 2 cents each. The mapped areas are widely scattered, nearly every State being represented. About 1,100 sheets have been engraved and printed; they are tabulated by States in the Survey's "List of Publications," a pamphlet which may be had on application.

The map sheets represent a great variety of topographic features, and with the aid of descriptive text they can be used to illustrate topographic forms. This has led to the projection of an educational series of topographic folios, for use wherever geography is taught in high schools, academies, and colleges. Of this series the first three folios have been issued, viz:

1. Physiographic types, by Henry Gannett. 1898. Folio. Four pages of descriptive text and the following topographic sheets: Fargo (N. Dak.-Minn.), a region in youth; Charleston (W. Va.), a region in maturity; Caldwell (Kans.), a region in old age; Palmyra (Va.), a rejuvenated region; Mount Shasta, (Cal.), a young volcanic mountain; Eagle (Wis.), moraines; Sun Prairie (Wis.), drumlins; Donaldsonville (La.), river flood plains; Boothbay (Me.), a fiord coast; Atlantic City (N. J.), a barrier-beach coast. Price 25 cents.

2. Physiographic types, by Henry Gannett. 1900. Folio. Eleven pages of descriptive text and the following topographic sheets: Norfolk (Va.-N. C.), a coast swamp; Marshall (Mo.), a graded river; Lexington (Nebr.), an overloaded stream; Harrisburg (Pa.), Appalachian ridges; Poteau Mountain (Ark.-Ind. T.), Ozark ridges; Marshall (Ark.), Ozark Plateau; West Denver (Colo.), hogbacks; Mount Taylor (N. Mex.), volcanic peaks, plateaus, and necks; Cucamonga (Cal.), alluvial cones; Crater Lake special (Oreg.), a crater. Price 25 cents.

3. Physical geography of the Texas region, by Robert T. Hill. 1900. Folio. Twelve pages of text (including 11 cuts); 5 sheets of special half-tone illustrations; 5 topographic sheets, one showing types of mountains, three showing types of plains and scarps, and one showing types of rivers and canyons; and a new map of Texas and parts of adjoining territories. Price 50 cents.

GEOLOGIC ATLAS OF THE UNITED STATES.

The Geologic Atlas of the United States is the final form of publication of the topographic and geologic maps. The atlas is issued in parts, or folios, progressively as the surveys are extended, and is designed ultimately to cover the entire country.

Under the plan adopted the entire area of the country is divided into small rectangular districts (designated *quadrangles*), bounded by certain meridians and parallels. The unit of survey is also the unit of publication, and the maps and descriptions of each rectangular district are issued as a folio of the Geologic Atlas.

Each folio contains topographic, geologic, economic, and structural maps, together with textual descriptions and explanations, and is designated by the name of a principal town or of a prominent natural feature within the district.

Two forms of issue have been adopted, a "library edition" and a "field edition." In both the sheets are bound between heavy paper covers, but the library copies are permanently bound, while the sheets and covers of the field copies are only temporarily wired together.

Under the law a copy of each folio is sent to certain public libraries and educational institutions. The remainder are sold at 25 cents each, except such as contain an unusual amount of matter, which are priced accordingly. Prepayment is obligatory. The folios ready for distribution are here listed:

No.	Name of sheet.	State.	Limiting meridians.	Limiting parallels.	Area, in square miles.	Price, in cents.
1	Livingston	Montana	110°-111°	45°-46°	3,354	25
2	Ringgold	Georgia Tennessee	85°-85° 30′	34° 30′-35°	980	25
3	Placerville	California	120° 30′-121°	38° 30′-39°	932	25
4	Kingston *a*	Tennessee	84° 30′-85°	35° 30′-36°	969	25
5	Sacramento	California	121°-121° 30′	38° 30′-39°	932	25
6	Chattanooga	Tennessee	85°-85° 30′	35°-35° 30′	975	25
7	Pikes Peak *a*	Colorado	105°-105° 30′	38° 30′-39°	932	25
8	Sewanee	Tennessee	85° 30′-86°	35°-35° 30′	975	25
9	Anthracite-Crested Butte.	Colorado	106° 45′-107° 15′	38° 45′-39°	465	50
10	Harpers Ferry	Virginia West Va Maryland.	77° 30′-78°	39°-39° 30′	925	25
11	Jackson	California	120° 30′-121°	38°-38° 30′	938	25
12	Estillville	Virginia Kentucky Tennessee	82° 30′-83°	36° 30′-37°	957	25
13	Fredericksburg	Maryland. Virginia	77°-77° 30′	38°-38° 30′	938	25
14	Staunton	Virginia West Va	79°-79° 30′	38°-38° 30′	938	25
15	Lassen Peak	California	121°-122°	40°-41°	3,634	25
16	Knoxville	Tennessee N.Carolina	83° 30′-84°	35° 30′-36°	925	25
17	Marysville	California	121° 30′-122°	39°-39° 30′	925	25
18	Smartsville	California	121°-121° 30′	39°-39° 30′	925	25
19	Stevenson	Alabama Georgia Tennessee	85° 30′-86°	34° 30′-35°	980	25
20	Cleveland	Tennessee	84° 30′-85°	35°-35° 30′	975	25
21	Pikeville	Tennessee	85°-85° 30′	35° 30′-36°	969	25
22	McMinnville	Tennessee	85° 30′-86°	35° 30′-36°	969	25
23	Nomini	Maryland. Virginia	76° 30′-77°	38°-38° 30′	938	25
24	Three Forks	Montana	111°-112°	45°-46°	3,354	50
25	London	Tennessee	84°-84° 30′	35° 30′-36°	969	25
26	Pocahontas	Virginia West Va	81°-81° 30′	37°-37° 30′	951	25
27	Morristown	Tennessee	83°-83° 30′	36°-36° 30′	963	25
28	Piedmont	Maryland. West Va	79°-79° 30′	39°-39° 30′	925	25
29	Nevada City: Nevada City Grass Valley Banner Hill	California	 121° 00′ 25″-121° 03′ 45″ 121° 01′ 35″-121° 05′ 04″ 120° 57′ 05″-121° 00′ 25″	 39° 13′ 50″-39° 17′ 16″ 39° 10′ 22″-39° 13′ 50″ 39° 13′ 50″-39° 17′ 16″	 11.65 12.09 11.65	50
30	Yellowstone National Park: Gallatin Canyon Shoshone Lake	Wyoming.	110°-111°	44°-45°	3,412	75
31	Pyramid Peak	California	120°-120° 30′	44°-45°	932	25
32	Franklin	Virginia West Va	79°-79° 30′	38° 30′-39°	932	25
33	Briceville	Tennessee	84°-84° 30′	36°-36° 30′	963	25
34	Buckhannon	West Va	80°-80° 30′	38° 30′-39°	932	25
35	Gadsden	Alabama	86°-86° 30′	34°-34° 30′	986	25
36	Pueblo	Colorado	104° 30′-105°	38°-38° 30′	938	50
37	Downieville	California	120° 30′-121°	39° 30′-40°	919	25
38	Butte Special	Montana	112° 29′ 30″-112° 36′ 42″	45° 59′ 28″-46° 02′ 54″	22.80	50
39	Truckee	California	120°-120° 30′	39°-39° 30′	925	25
40	Wartburg	Tennessee	84° 30′-85°	36°-36° 30′	963	25
41	Sonora	California	120°-120° 30′	37° 30′-38°	944	25
42	Nueces	Texas	100°-100° 30′	29° 30′-30°	1,035	25
43	Bidwell Bar	California	121°-121° 30′	39° 30′-40°	918	25
44	Tazewell	Virginia West Va	81° 30′-82°	37°-37° 30′	950	25
45	Boise	Idaho	116°-116° 30′	43° 30′-44°	864	25
46	Richmond	Kentucky	84°-84° 30′	37° 30′-38°	944	25
47	London	Kentucky	84°-84° 30′	37°-37° 30′	950	25
48	Tenmile District Special.	Colorado	106° 8′-106° 16′	39° 22′ 30″-39° 30′ 30″	55	25
49	Roseburg	Oregon	123°-123° 30′	43°-43° 30′	871	25

a Out of stock.

No.	Name of sheet.	State.	Limiting meridians.	Limiting parallels.	Area, in square miles.	Price, in cents.
50	Holyoke	Mass. Conn	72° 30′–73°	42°–42° 30′	885	50
51	Big Trees	California	120°–120° 30′	38°–38° 30′	938	25
52	Absaroka: Crandall Ishawooa	Wyoming.	109° 30′–110°	44°–44° 30′	1,706	25
53	Standingstone	Tennessee	85°–85° 30′	36°–36° 30′	963	25
54	Tacoma	Washington.	122°–122° 30′	47°–47° 30′	812	25
55	Fort Benton	Montana	110°–111°	47°–48°	3,273	25
56	Little Belt Mts.	Montana	110°–111°	46°–47°	3,295	25
57	Telluride	Colorado	107° 45′–108°	37° 45′–38°	236	25
58	Elmoro	Colorado	104°–104° 30′	37°–37° 30′	950	25
59	Bristol	Virginia Tennessee	82°–82° 30′	36° 30′–37°	957	25
61	Monterey	Virginia West Va.	79° 30′–80°	38°–38° 30′	938	25
62	Menominee Special.	Michigan.	(a NW.-SE. area, about	22 m. long, 6½ wide)	150	25
63	Mother Lode	California	(a NW.-SE. rectangle,	70 m. long, 6½ wide)	455	50
64	Uvalde	Texas	99° 30′–100°	29°–29° 30′	1,040	25
65	Tintic Special	Utah	111° 55′–112° 10′	39° 45–40°	229	25

STATISTICAL PAPERS.

Mineral Resources of the United States, 1882, by Albert Williams, jr. 1883. 8°. xvii, 813 pp. Price 50 cents.

Mineral Resources of the United States, 1883 and 1884, by Albert Williams, jr. 1885. 8°. xiv, 1016 pp. Price 60 cents.

Mineral Resources of the United States, 1885. Division of Mining Statistics and Technology. 1886. 8°. vii, 576 pp. Price 40 cents.

Mineral Resources of the United States, 1886, by David T. Day. 1887. 8°. viii, 813 pp. Price 50 cents.

Mineral Resources of the United States, 1887, by David T. Day. 1888. 8°. vii, 832 pp. Price 50 cents.

Mineral Resources of the United States, 1888, by David T. Day. 1890. 8°. vii, 652 pp. Price 50 cents.

Mineral Resources of the United States, 1889 and 1890, by David T. Day. 1892. 8°. viii, 671 pp. Price 50 cents.

Mineral Resources of the United States, 1891, by David T. Day. 1893. 8°. vii, 630 pp. Price 50 cents.

Mineral Resources of the United States, 1892, by David T. Day. 1893. 8°. vii, 850 pp. Price 50 cents.

Mineral Resources of the United States, 1893, by David T. Day. 1894. 8°. viii, 810 pp. Price 50 cents.

On March 2, 1895, the following provision was included in an act of Congress:

"*Provided*, That hereafter the report of the mineral resources of the United States shall be issued as a part of the report of the Director of the Geological Survey."

In compliance with this legislation the following reports have been published:

Mineral Resources of the United States, 1894, David T. Day, Chief of Division. 1895. 8°. xv, 646 pp., 23 pl.; xix, 735 pp., 6 pl. Being Parts III and IV of the Sixteenth Annual Report.

Mineral Resources of the United States, 1895, David T. Day, Chief of Division. 1896. 8°. xxiii, 542 pp., 8 pl. and maps; iii, 543–1058 pp., 9–13 pl. Being Part III (in 2 vols.) of the Seventeenth Annual Report.

Mineral Resources of the United States, 1896, David T. Day, Chief of Division. 1897. 8°. xii, 642 pp., 1 pl.; 643–1400 pp. Being Part V (in 2 vols.) of the Eighteenth Annual Report.

Mineral Resources of the United States, 1897, David T. Day, Chief of Division. 1898. 8°. viii, 651 pp., 11 pl.; viii, 706 pp. Being Part VI (in 2 vols.) of the Nineteenth Annual Report.

Mineral Resources of the United States, 1898, by David T. Day, Chief of Division. 1899. 8°. viii, 616 pp.; ix, 804 pp., 1 pl. Being Part VI (in 2 vols.) of the Twentieth Annual Report.

The money received from the sale of the Survey publications is deposited in the Treasury, and the Secretary of the Treasury declines to receive bank checks, drafts, or postage stamps. All remittances, therefore, must be by MONEY ORDER, made payable to the Director of the United States Geological Survey, or in CURRENCY—the exact amount. Correspondence relating to the publications of the Survey should be addressed to—

THE DIRECTOR,
UNITED STATES GEOLOGICAL SURVEY,
WASHINGTON, D. C.

WASHINGTON, D. C., *November, 1900.*